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ANALYSIS OF RECRUITING COSTS BY INTEREST AND APTITUDE

Daniel L. Leighton
D. Alton Smith

Systems Research and Applications Corporation
1777 Northeast Loop 410, Suite 510
San Antonio, Texas 78217

Gary L. Macomber, Capt, USAF
Janelle K. Viera, 1st Lt, USAF

HUMAN RESOURCES DIRECTORATE
MANPOWER AND PERSONNEL RESEARCH DIVISION
7909 Lindbergh Drive
Brooks AFB, Texas 78235-5352

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Janelle K Viera

JANELLE K. VIERA, 1Lt, USAF
Project Scientist

PATRICK C. KYLLONEN
Technical Director
Manpower and Personnel Research Division

Gary D. Zank

GARY D. ZANK, Colonel, USAF
Chief
Manpower and Personnel Research Division

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Daniel L. Leighton   Gary L. Macomber, Capt, USAF
D. Alton Smith   Janelle K. Viera, 1st Lt, USAF

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This study developed an analytical model of Air Force nonprior service (NPS) enlisted recruiting costs reflecting the way the Air Force recruits and its sensitivity to certain factors. These factors include the numbers and aptitude requirements of entry-level positions and the aptitudes and interests of the applicant population. After reviewing recruiting modeling literature and evaluating modeling strategies, a hybrid approach, combining cost accounting and statistical modeling, was selected. A conceptual model was constructed and the data requirements identified. Data collection consisted of two surveys and extracting data from historical files. One survey measured recruits' interest in Air Force job clusters. The other obtained recruiting difficulty ratings from recruiters. Historical data was used to obtain cost information, applicant numbers, numbers of recruiters assigned, aptitude distributions, and first-term job distribution. The data was used to estimate model parameters and develop a spreadsheet. The model produced estimates of recruiting difficulty consistent with experienced recruiter judgements; its cost estimates were within 2 percent of actual costs (FY90-93). The model offers a promising analytical framework for evaluating Air Force enlisted recruiting and personnel policy. Future work could include evaluating a broader sample of applicants and cost data, and enhancing the model software's usability.

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PREFACE

This analysis of non-prior service recruiting costs by recruit aptitude and interest is part of an on-going Air Force research program to develop the technology necessary to base selection, classification and personnel management policies on empirically-derived cost and performance data. This effort was undertaken by the Manpower and Personnel Research Division, Human Resources Directorate, Air Force Armstrong Laboratory as part of Work Unit 77192409, "Analysis of Recruiting Costs by Interest and Aptitude."

The project was conducted from June 1993 to May 1994 with the overall objective of developing a model of Air Force non-prior service (NPS) enlisted recruiting cost that:

- accurately reflects the way the Air Force actually recruits;

- is sensitive to Air Force enlistment requirements (numbers of enlistments) and aptitude requirements for specific Air Force Specialties (AFSs);

- is sensitive to the aptitude and occupational interests of the youth population; and

- accurately estimates the cost of recruiting to fill a given set of requirements.

The authors wish to express their appreciation to the men and women of the US Air Force Recruiting Service for their time and assistance in helping gather the data necessary to conduct this analysis. In particular, Mr. George Germadnik, Headquarters Air Force Recruiting Service, Market Analysis Branch, was most helpful in arranging meetings, site visits, and survey mailings, and in answering a myriad of questions about Air Force recruiting operations. We also wish to acknowledge the technical assistance of Mr. Mike Simmons (SRA Corporation) in building the complex databases and running most of the analyses described in this report. Dr. Tim Cooke (also of SRA) provided valuable insight into the economics of military recruiting, and reviewed all of the work in progress for quality and accuracy.

The authors also thank Mr. Larry Looper and Dr. Jacobina Skinner of the Manpower and Personnel Research Division for their guidance and suggestions throughout the project; Ms Sharon McDonald for assistance in the preparation of the manuscript; and, Colonel William J. Strickland, Director of the Human Resources Directorate, Armstrong Laboratory (and a former Air Force recruiter) for his support and assistance.

ANALYSIS OF RECRUITING COSTS BY INTEREST AND APTITUDE

SUMMARY

This project involves the development and validation of a new methodology for quantifying the relationship between the aptitudes and job interests of the non-prior military service (NPS) youth population, the kinds and numbers of Air Force enlisted positions to be filled, and the cost of recruiting to fill those positions. Recruiting activities can be categorized as either "prospecting" (encouraging people to apply for enlistment) or "processing" (screening, testing, and selecting applicants). For the Air Force, the prospecting process is designed to attract applicants interested in the Air Force in general rather than those qualified and interested only in specific specialties -- applicants are then matched to a particular specialty during the processing phase.

In this study, Air Force enlisted specialties are grouped into 12 categories based on job type (mechanical, administrative, electronic, and general) and required aptitude level within each type (high, medium, and low). Given the number of enlistments required in each of the 12 job categories, and the proportion of applicants who are both qualified and interested in each category, the model first calculates the number of applicants required to fill the available positions in each category (a measure of recruiting difficulty), and then converts the number of applicants to dollars using a statistically-derived equation relating applicants, recruiters, and costs.

To estimate the parameters of the model, an occupational interest survey was developed and administered to a sample of recruits in Air Force Basic Military Training (BMT); when combined with Armed Services Vocational Aptitude Battery (ASVAB) scores, these data provide an estimate of the joint distribution of aptitude and interest among applicants. Entry-level job requirements were then obtained from an analysis of historical personnel files. From these results, the numbers of applicants required to fill each job category were calculated.

For validation, a recruiting difficulty survey was developed and administered to a sample of experienced recruiters. The correlation between recruiting difficulty indices generated by the model and those obtained from the survey is .78. A regression equation relating the number of applicants processed (variable costs) and the number of recruiters supported (fixed costs) to the total annual cost of recruiting was then estimated using FY 90-93 historical data ($R^2 = .95$). This equation is used in the model to convert applicant requirements into dollar costs.

The following are some examples of how the model, which is implemented in a spreadsheet, could be used: (1) quantifying the impact on recruiting difficulty (and thus cost) of changes in Air Force enlistment requirements; (2) determining which jobs in a mix of enlistment requirements could be most difficult to fill; and (3) estimating the savings in recruiting costs of targeting incentives at individuals with high-demand aptitudes and interests.

INTRODUCTION

Background

Since the advent of the all-volunteer force, the Office of the Secretary of Defense, the Army, and the Navy have all sponsored research to develop enlisted recruiting supply and cost models to help justify recruiting budgets and to plan and allocate the recruiting resources necessary to meet Army and Navy

enlistment requirements. The Air Force has not been as active a participant in this research because recruiting has not been as big a concern for that service. With the exception of a small shortfall in Fiscal Year (FY) 1979, the Air Force has always met its overall numerical enlistment goals, with recruits who generally scored higher on the Armed Forces Qualifying Test (AFQT) composite of the Armed Services Vocational Aptitude Battery (ASVAB) than did recruits from the other services, and were recruited with far fewer recruiters and advertising dollars than the Army or Navy. For example, Table 1 compares enlistment goals, enlisted recruiting resources, and AFQT category I and II percentages across the four services for FY 93[1]. The data are from the Department of Defense (DoD); enlisted recruiting resources are in millions of dollars, reflecting advertising (service specific and joint), military and civilian pay, enlistment bonuses, all support costs (travel, per diem, communications, vehicles, office leases, etc.), and training.

Table 1. FY 93 Recruiting Comparisons

Service	NPS Goal	Enlisted Recruiting Resources	AFQT CAT I&II (Oct-Mar)
Army	70,000	$513.1.M	37%
Navy	63,156	$291.4M	44%
Marines	34,800	$143.9M	38%
Air Force	31,500	$101.9M	51%

As the DoD draws down in the post-Cold War era, recruiting issues may become increasingly more important to Air Force planners and managers. From FY 90 to FY 93, the Air Force enlisted advertising budget declined by over 60 percent, from $6.3 million to $2.5 million. During the same period the number of assigned non-prior service (NPS) recruiters declined nearly 24 percent, from 1,246 in October 1989 to 950 in September 1993. Even with the reduced NPS goals associated with a smaller Air Force, the declining resources available for recruiting, coupled with a growing perception on the part of the civilian population that the services are not hiring and are no longer a secure career option, Air Force enlisted recruiting has become more difficult (West, 1993).

During the first half of FY 93 the Air Force saw its high quality[2] accessions decline for the first time in many years -- down to 79 percent of all accessions from 85 percent in the first half of FY 92. The DoD Youth Attitude Tracking Survey (YATS) further confirms the deteriorating recruiting market. From the fall of 1989 to the fall of 1992 (the most recent data reported), the proportion of 19-21 year old males surveyed who expressed a positive propensity to enlist in the Air Force declined from 11.6 percent to 9.2 percent (Wilson, Nieva, Kolmstetter, & Greenlees, 1993). To continue recruiting a quality force in spite of declining resources and a deteriorating recruiting market, Air Force analysts and planners need a better understanding of recruiting market dynamics and costs so that resources can be efficiently allocated and

[1] The AFQT Categories and percentile scores are as follows: Category I = 93-99; Category II = 65-92; Category IIIA = 50-64; Category IIIB = 31-49; Category IV = 10-30; Category V = 1-9.

[2] These figures are based on the standard Department of Defense definition of high quality accessions, i.e., AFQT Category I-IIIA high school diploma graduates (HSDG).

budget requests can be fully articulated and justified. Providing some of the technology to fill that need is the primary purpose of this research effort.

Research Objectives

The specific objective of this project is to develop a model of Air Force NPS enlisted recruiting costs that: (1) accurately reflects the way the Air Force recruits (i.e., has face validity); (2) is sensitive to the aptitude levels and numbers of enlistments the Air Force needs; (3) is sensitive to the aptitude and occupational interests of the youth population; and (4) accurately estimates the costs of recruiting to fill a given set of enlistment requirements.

CONCEPTUAL MODEL DEVELOPMENT

The Air Force Recruiting Process

The first step in developing a conceptual model of the cost of recruiting was to gain insight into the current Air Force recruiting process. This was done in a series of focus group discussions at Headquarters Air Force Recruiting Service (at Randolph AFB, Texas), at a recruiting squadron (the 341st, at Lackland AFB, Texas), and at a Military Entrance Processing Station (MEPS), in San Antonio, Texas.

Air Force Recruiting Service, commanded by a brigadier general, is headquartered at Randolph AFB, Texas. Under Recruiting Service headquarters there are 4 Recruiting Groups, each commanded by a colonel, responsible for geographic sectors of the United States. The groups are located as follows:

Western Region: 372nd Recruiting Group, Hill AFB, Utah
Central Region: 369th Recruiting Group, Lackland AFB, Texas
Southeast Region[3]: 367th Recruiting Group, Robbins AFB, Georgia
Northeast Region: 360th Recruiting Group, Hanscom AFB, Massachusetts

Under the groups there are a total of 29 recruiting squadrons, each commanded by a major or lieutenant colonel, with specific geographic responsibilities. Each squadron consists of several flights, again with geographic responsibilities. The flights consist of a flight supervisor (usually a master sergeant) with 3 or 4 "bag carrying" recruiters (generally staff or technical sergeants), about 65 percent of whom are located in one-person offices. Almost 85 percent of Air Force recruiting offices are collocated with recruiting offices of the other services.

In terms of modeling the cost of recruiting, an important finding from analyzing the Air Force enlisted recruiting process is that the Air Force does not have formal programs (goals, bonuses, education benefits, targeted recruiting, etc.) to recruit specific categories of people; accordingly, Air Force recruiters do not "sell" specific Air Force jobs until well into the enlistment process. This does not mean that recruiters are unaware of Air Force job requirements. They know what recruit interests and aptitudes are likely to obtain a quick job match, and what types of recruits will remain in a "qualified and waiting" status for an extended period. Since job reservations are the basis for the recruiters' goals and rewards, it is obviously in their best

[3] The 367th includes part of the upper midwest (Indiana, Illinois, Michigan) as well.

interest to obtain applicants who fit Air Force requirements. However, the process by which they do this varies across recruiters and locations, depending on the individual recruiter's ability, preference, and recruiting environment.

Air Force recruiting resources are basically spent on two categories of activities, prospecting and processing. Figure 1 is a flow chart showing the major steps required to get a civilian off the street and into an Air Force job.

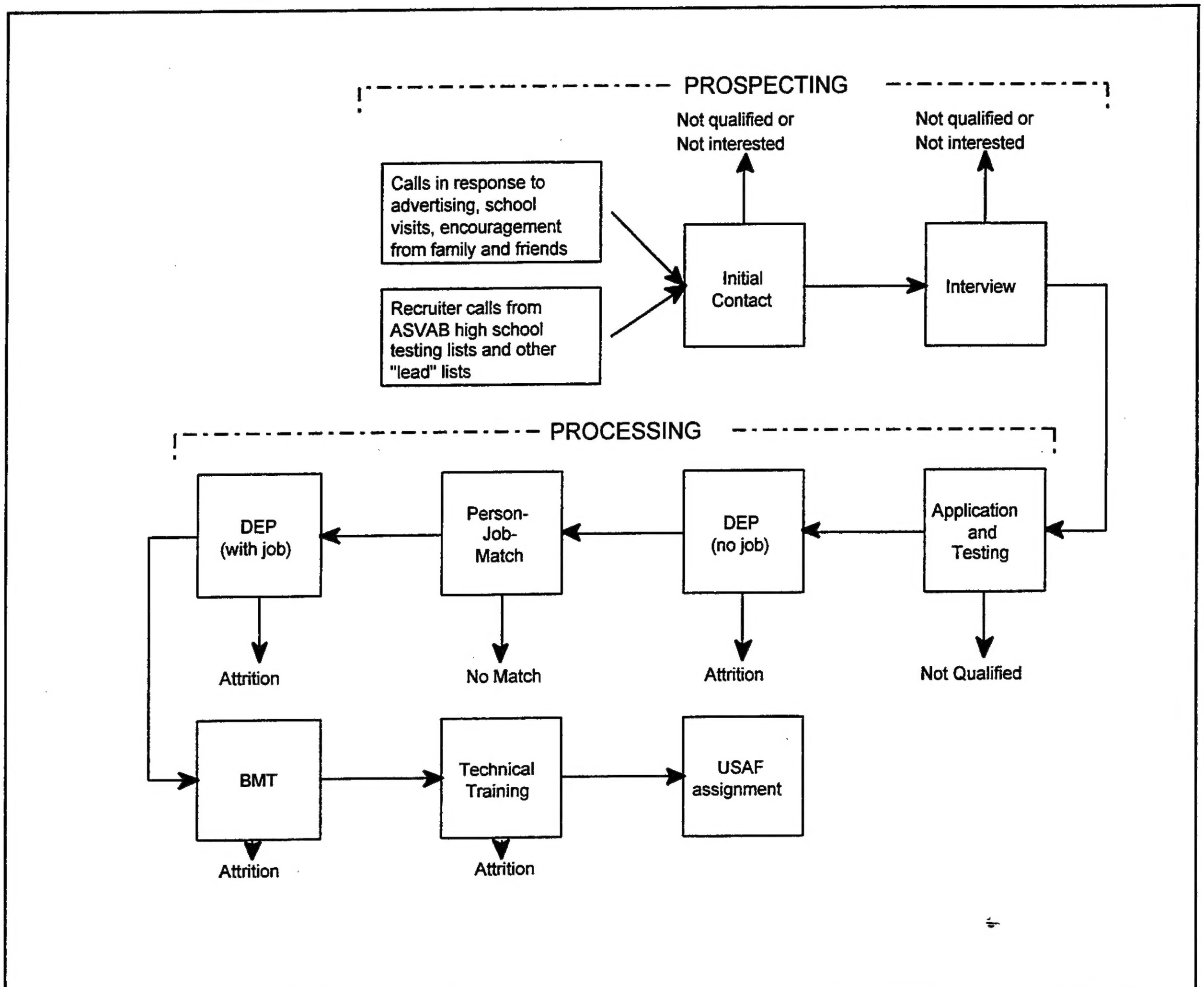

Figure 1. The Recruiting and Enlistment Process.

Prospecting activities consist of advertising and recruiter outreach programs (e.g., high school and college visits, job fairs, air shows, mail-outs, phone calls) designed to stimulate general interest in the Air Force. This results in contacts, interviews, and ultimately applications for enlistment. This phase of the recruiting process is essentially "job neutral" -- recruiters are discouraged from discussing specific Air Force job opportunities and are not given specific goals by AFQT category or Air Force Specialty (AFS). They are told to "sell" the Air Force as a way of life and as an opportunity for advanced training and education. The theory is that by continually generating a flow of applications, the Air Force can then pick and choose from among the applicants and enlist the ones who best fit current job requirements.

In the processing phase, applicants are interviewed and tested to screen those not qualified for enlistment. During this phase the recruiter has considerable latitude in deciding who to send to the MEPS for testing and who to send home. It is here that the informal job matching process really begins in that recruiters can decide not to send an enlistment-qualified candidate to the MEPS if he or she feels that the candidate may not be qualified or interested in the kinds of jobs currently available. After MEPS testing, the fully-qualified applicants are enlisted into the Delayed Entry Program (DEP) and are placed on a "Q&W" (qualified and waiting) list, still without a job or specific enlistment date. At that point, the formal person-job-match process begins. Air Force Recruiting Service has experimented with a variety of person-job-match processes over the years, including an on-line, near real-time sequential system; an overnight batch process; a daily dial-in, first-come, first-served approach (the process in place at the start of this project); and a decentralized process where jobs are prorated out to the groups for manual matching with applicants (the process in place as of this writing).

The job-neutral recruiting strategy used by the Air Force has inherent inefficiencies because it may attract applicants who do not match job requirements, while potentially not attracting enough of those who have the required aptitudes and interests. However, the strategy has worked in the all-volunteer environment because of the relatively low demand for Air Force recruits (compared to the Army) and the large supply of individuals wanting to enlist in the Air Force. The Army, and to a lesser extent the Navy, have had to target their recruiting resources much more specifically than has the Air Force to meet their job needs. If the recruiting environment continues to deteriorate for the Air Force and recruiting resources continue to diminish, the Air Force may have to consider alternative recruiting strategies that target more directly those individuals with the interests and qualifications the Air Force needs the most.

Literature Review - Recruiting Cost Modeling Approaches

One approach to analyzing recruiting cost commonly found in the literature is to simply allocate the total cost of recruiting (i.e., the recruiting budget for some time period) equally to each enlistment obtained during the time period. This average unit cost approach is useful for high-level, aggregate analyses, or situations where the future recruiting market, environment, and mix of requirements can be assumed to mirror the historical period used to develop the average cost. This approach was used in Faneuff, Valentine, Stone, Curry, and Hageman (1990) in a prototype model designed to set minimum cost enlistment standards based on the Time To Proficiency (TTP) model of job performance. However, the authors recognized the shortcoming of this costing approach in the following statement (page 3-4):

> Ideally, costs should be modeled as a function of both time in service and aptitude level. Costs by aptitude data are important because recruiting costs probably differ with aptitude level. Recruiting higher aptitude individuals probably costs more due to their higher opportunity costs . . . However, cost by aptitude level data were not available . . .

A slight variation on the average unit cost approach is to assume that recruiting costs, while independent of the quality of the recruits, do vary with the number recruited. In a non-military application, Martin and Raju (1992) used an increasing marginal cost approach to modify an earlier utility analysis model used for setting optimum cut-scores on selection tests. The authors then applied the model in two case studies, one in which salesperson productivity was the performance criterion, and another in which truck driver accident costs was the performance criterion.

A more sophisticated variation of the cost approach involves allocating the total cost of recruiting to the specific activities involved in generating enlistments. This approach, called Activity Based Costing (ABC), is used in the private sector to determine product or service costs where multiple products or services are being produced in the same organization. ABC is also a component of the official DoD business process improvement program under the Corporate Information Management (CIM) initiative. An ABC model of Air Force recruiting was produced under the CIM program (OASD/FM&P, 1992). This model used Subject Matter Experts (SMEs) to first define the activities involved in Air Force enlisted recruiting and then allocate actual costs to the various activities. Using the Integrated Computer and Manufacturing (ICAM) DEFinition (IDEF) methodology, the SME's developed a 4-level hierarchical recruiting activity model involving 37 separate and distinct activities, and then allocated FY 92 Air Force enlisted recruiting cost to the activities. For example, the SME's estimated that in FY 92, 15 percent of the Air Force's enlisted recruiting budget was spent on policy, planning and management, 40 percent was spent on maintaining public awareness of the Air Force and in generating leads, 16 percent was spent on prospecting for applicants, and 29 percent was spent on processing applicants. This model could be extended to estimate the cost of recruiting different categories of recruits if the average cost per activity could be calculated, and if the number of activities to obtain an enlistment from each category could be estimated.

Another form of cost accounting was used by Cooke and Jondrow (1990) to develop a methodology for estimating the cost of recruiting alternative distributions of AFQT scores. After describing the Navy recruiting process in detail, Cooke and Jondrow (1990) conclude (p. 12):

> The most important implication of the above description of processing and prospecting is that recruiters cannot allocate their recruiting time to individual categories of prospects. Thus, it is not possible to allocate costs to these categories. For example, it is not feasible to estimate the costs of recruiting enlistees in AFQT Category I because these costs can not be disentangled from those of recruiting other categories. What is feasible to estimate is the cost of recruiting enlistees in all the mental categories taken together, and how this cost responds to changes in the mix of different AFQT categories.

Cooke and Jondrow (1990) then go on to develop a model that divides the enlisted recruiting market into two parts (school and work) with different (assumed) distributions of AFQT scores. By estimating the number of applicants obtained per recruiter prospecting in each market, they can estimate the minimum number of recruiters required to obtain a specified mix of AFQT scores. The number of recruiters can then be converted into recruiting costs by assuming that all costs of recruiting increase proportionally with the number of recruiters. Their model is calibrated using FY 87 DoD-wide recruiting data.

In addition to the cost accounting methods described above, another approach frequently found in the literature is the statistical approach. For recruiting analysis applications, this approach requires either time series or cross-sectional observations of the number of enlistments from each recruit category of interest, measures of the resources spent producing the enlistments, and the conditions under which the enlistments were obtained (unemployment rate, etc.). From these data, production functions can be estimated relating inputs (resources and market conditions) to outputs (enlistments).

Dertouzos (1985) used this approach to estimate the effects of incentives and quotas on high and low quality enlistments, using Army recruiting data from 1980 and 1981. This study found that the trade-off between low and high quality army recruits is about 4 to 1 in terms of recruiter effort (i.e., it takes 4 times the effort to enlist a Category I-IIIA HSDG than it does to recruit a Category IV HSDG or any non-graduate).

Daula and Smith (1985) also used the statistical approach to estimate Army enlistment supply models for high quality recruits. Note that the techniques used by both Dertouzos (1985) and Daula and Smith (1985) consider only two categories of recruits, high quality (Category I-IIIA HSDG) and low quality (everyone else). This is because the statistical approach will only work for recruit categories that are supply constrained. Both of these studies assume that the Army will take all the high quality recruits it can get, back filling its overall enlistment requirement with lower quality individuals, for which there is assumed to be an excess of supply over demand. The technique also requires a data set in which there is sufficient variation in the number of enlistments to get precise estimates of the parameters of the model. Also, neither of these studies attempt to estimate the dollar costs of recruiting a particular mix of people.

Smith and Hogan (1992) developed a cost function for the OSD Cost-Performance Tradeoff Model (CPTM) based on a statistically estimated production function for high, medium, and low quality recruits. The cost function solves for the mix of recruiting resources (advertising, recruiters, and incentives) that will produce a specified mix of high, medium and low recruit quality at minimum cost. The model then applies resource prices to produce dollar estimates of recruiting costs.

Morey (1991) also developed a statistical cost model, using monthly Navy recruiting data from FY 84-86, to evaluate the impact of DEP policies on Navy recruiting cost. He found that the DEP is an important management tool and that recruiting costs go down as the number of high quality recruits in the DEP go up.

Appendix A contains an annotated bibliography of additional references related to military recruiting market analysis. While none of these references directly address the issue of recruiting cost by interest and aptitude, they do provide insight into the dynamics of recruiting supply and demand.

Methods Analysis and Recommendations

From the literature review there emerge two basic approaches that could be used to develop an Air Force recruiting cost model; i.e., the *cost accounting approach*, or the *statistical approach*. Each method has strengths and weaknesses relative to the current application. In selecting a method for model development, the following questions need to be considered: Would the resulting model accurately reflect the way the Air Force actually recruits (i.e., would it have face validity)? Would it be sensitive to enlistment requirements (numbers of enlistments) and aptitude levels the Air Force needs? Would it be sensitive to the aptitude and occupational interests of the youth population? And would it produce accurate estimates of the total cost of recruiting to fill a given set of enlistment requirements?

In addition to the appropriateness of the model resulting from the selected method, the data required to estimate the parameters of the model must also be considered. Are the data required to estimate the parameters of the model available from multiple sources (for validation) at a reasonable expenditure of time, money, and other resources? Also, are the data available on a continuing basis for update?

Table 2 summarizes these method selection criteria and provides a rating of how well each method meets the criterion.

The rationale for the ratings is as follows:

1. In theory, either method is general enough to be used to produce an accurate model of the actual Air Force enlisted recruiting process, if adequate data were available to determine the model's parameters.

2. Because of its static nature, a pure cost accounting approach could not be used to produce a model that can accurately estimate recruiting costs over a wide range of conditions. However, this might not be important if all that is required are forecasts one or two time periods ahead. On the other hand, this is the strongest characteristic of the statistical approach because it uses historical data that reflect a variety of conditions.

Table 2. Method Evaluation

Criterion	Cost Accounting	Statistical
Reflects actual AF recruiting process	1	1
Generate accurate cost estimates	3	1
Sensitive to enlistment and job requirements	1	3
Sensitive to recruit aptitudes and interests	1	3
Data are available	2	2
Multiple data sources	2	3
Data available at reasonable cost	3	2
Data available for update	3	2

1 = The method could produce a model that adequately meets the criterion
2 = The method could produce a model that would only partially meet the criterion
3 = A model produced by the method would not meet the criterion at all

3. Because it is not tied to the structure of historical data bases, the cost accounting approach is better equipped to handle a variety of job and recruit categories than is the statistical approach. Statistical models also become extremely difficult to estimate for large numbers of categories, even if the data are available.

4. Given the required multiple recruit/job categories of the current effort, the availability of data to support either approach would be problematic, but not impossible.

5. Again, because it is not necessarily tied to existing historical data sources, the cost accounting approach is more likely to produce a model with parameters that can be estimated from multiple sources than could a statistical model.

6. Data to estimate the parameters of a statistical model are generally less expensive to obtain than data for a cost accounting model because they reside in existing data bases. Cost accounting data often must be gathered from diverse sources using labor intensive methods (e.g., surveys, SME workshops).

7. Statistical models are also easier to update than cost accounting models, again because of their reliance on standard data bases rather than ad hoc data sources.

Without attempting to weight the relative importance of the criteria, the total score obtained from this analysis indicates that the cost accounting approach is slightly preferable to the statistical approach, by a score of 16 to 17 (lower values being better). However, the difference in scores is well within the error of this subjective evaluation.

Since there is no clear-cut advantage of one approach over the other, we recommend combining the best features of both approaches into a hybrid model. The cost accounting approach offers a more effective way to handle the core interests and problems of the present study (i.e., recruit aptitudes and interests, as well as enlistment and job requirements). Therefore, it could be used to model costs, in terms of the number of applicants required to achieve a required number of enlistments, of recruiting different interests/aptitude groups. A statistical model could then be developed to convert applicant requirements into dollar costs under various conditions. While we are not aware of a precedent for this approach, we believe it is a natural extension of prior work that will provide the Air Force with a robust recruiting cost model that satisfies all four objectives of the project at reasonable cost.

Conceptual Model Description

The cost accounting approach is based on the premise that the cost of recruiting a particular type of person (i.e., the cost of getting one of that type of person to enlist) is a function of how frequently that type of person appears in the pool of applicants. For example, if there are typically 10 people of type A and 20 people of type B in every group of 100 applicants, it will, on average, require 10 applicants to get one type A enlistment and 5 applicants to get one type B enlistment. Because obtaining applicants costs money (e.g., advertising, recruiter activity, processing, etc.), in this example, each type A enlistment costs twice as much as each type B enlistment because twice as many applicants are required. The proposed hybrid model uses this approach to initially estimate the unit cost, in terms of the number of applicants required, to obtain one enlistment of each type, and then uses a statistically-derived equation to convert the number of applicants to a dollar cost. Mathematically, the model can be expressed as:

$$C_i = \frac{c}{p_i} \tag{1}$$

Where: C_i = The dollar cost of enlisting one person of type i
c = The dollar cost per applicant
p_i = Proportion of all applicants who are type i

Equation (1) gives the unit cost of one type i enlistment. The total cost of N_i enlistments is as follows:

$$TC_i = c\left(\frac{N_i}{p_i}\right) \tag{2}$$

Where: TC_i = The dollar cost of enlisting N people of type i

In this equation, the term (N_i/p_i) can be interpreted as a measure of the difficulty in filling the requirements for people of type i, since it reflects the total number of applicants that will have to be generated to fill the total requirement. Thus, the recruiting difficulty for type i jobs is a function of both the demand for type i people (N_i), and the supply of type i people expressed as a proportion (p_i) of the total supply.

The first step in articulating this model of Air Force recruiting cost was the selection of the people types (the i's). The next step involved estimating the parameters of the model (i.e., the p_i's, the N_i's, and c). The final step was validating the model with external data sources. The remainder of this report describes these steps.

MODEL PARAMETER ESTIMATION

Selection of Recruit Categories

The two primary factors that affect the matching of enlisted people with jobs in the Air Force are aptitude and interest. Aptitude is important because it has been shown to be a predictor of success in technical training (Ree & Earles, 1991), a predictor of on-the-job performance (Dickinson & Teachout, 1991), and a predictor of productivity (Carpenter, Monaco, O'Mara, & Teachout, 1989). Interest is also important because it has a positive effect on job satisfaction and retention (Alley, Wilbourn, & Berberich, 1976) -- and it is a crucial element of the all-volunteer force, since people cannot be forced into a job they do not want. The Air Force categorizes all of its enlisted jobs into four basic types of work: mechanical, electronic, administrative, and other (general). Because this structure is so ingrained in the Air Force enlisted personnel management system, it makes sense to use it in categorizing recruit interests. Within each of these four job types, the Air Force further classifies jobs based on the minimum aptitude level required for entry into the job. Individuals are assigned to jobs based on their interest in the job and their aptitude for the job as measured by their score on the appropriate ASVAB composite (M - mechanical, A - administrative, G - general, E - electronic).

To establish the aptitude categories within each of the four major job types (MAGE), a discussion was held with a group of five experienced recruiters at Headquarters Air Force Recruiting Service (four technical sergeants and a master sergeant, all with prior field recruiting and MEPS Liaison Noncommissioned Officer (LNCO) experience). The recruiters were presented with a preliminary categorization of aptitude levels (using ASVAB composite score percentiles in each of the four categories) based on the way the Air Force groups jobs for its general job categories, called open aptitude index (open AI) enlistment contracts. This initial breakout had four aptitude levels within each area. After discussion with the recruiters, it was decided to reduce the number of aptitude levels to three within each area, representing high, medium, and low aptitude. The break points between categories were also established by the recruiters in such a way that the jobs falling in each category are equally easy (or difficult) to fill. The

resulting categories, to be used in the remainder of this study, are shown in Figure 2. Note that the categories are labeled M1, M2, M3, etc. for ease of reference.

Joint Distribution of Aptitude and Interest

The next step in articulating the recruiting cost model was to estimate the distribution of people types across the applicant pool (the p_i's). Since types are defined along two dimensions (aptitude and interest), what is really required is the joint probability distribution of both interest and aptitude across applicants. While aptitude data are readily available for applicants, interest data are problematic. During processing at the MEPS, each qualified applicant is asked to record his or her preference for jobs in each of the four aptitude areas using a 0 to 9 scale (9 being the highest) without repeating a rating. These data are maintained in the Air Force's Procurement Management Information System (PROMIS) and are used in matching applicants with jobs. However, an examination of the data revealed a very pronounced pattern of responses.

INTEREST AREAS

ASVAB COMPOSITE PERCENTILES	Mech	Admin	Gen	Elect
	$\geq$ 61 M1	$\geq$ 61 A1	$\geq$ 69 G1	$\geq$ 72 E1
	51-60 M2	45-60 A2	43-68 G2	67-71 E2
	$\leq$ 50 M3	$\leq$ 44 A3	$\leq$ 42 G3	$\leq$ 66 E3

Figure 2. Aptitude/Interest Categories

For the vast majority of cases, only four scale points are used -- 0,1,2, and 9. Apparently applicants are giving a 9 to the one area they want most (or are most likely to get a job in, based on counseling by the LNCO), and rating the other three areas as low as possible (0,1, and 2). So, instead of providing a measure of the applicant's relative interest in all four areas, the PROMIS data only provides a measure of the one area of primary interest. Because both the LNCO and the applicant want to maximize the probability of a job match, even the primary area of interest is probably biased toward the areas with the largest number of available jobs at the time of processing. In the absence of reliable interest data in PROMIS, it was decided to collect interest data specifically for this project using an occupational interest survey tailored to the purpose. The next sections describe the development and administration of that survey.

Clustering AFSs into Job Groups

The first step in developing the occupational interest survey was to select the level of detail at which jobs would be described on the survey. At one extreme, each job or AFS could be listed and rated separately on the survey form. This, however, would produce an extremely long and tedious survey (nearly 200 items) with very technical titles (e.g., Instrumentation and Telemetry System Specialist) that would have little meaning to the typical applicant. Also the differences among some AFSs are of little significance to most applicants (e.g., the difference between an F-15 Avionics System Specialist and an F-16 Avionics

System Specialist). At the other extreme, the survey could follow the PROMIS format and list only the four major job categories. This high level of aggregation, however, masks significant differences in jobs that might affect interest, especially in the general area which includes everything from musician to policeman. To overcome these problems it was decided to create an intermediate level of job detail by clustering AFSs into 20 to 40 groups that have common duties and characteristics such that if an applicant is interested in one AFS in the group, he or she would probably be interested in the other AFSs in the group as well.

The clustering was done by considering the aptitude requirements and the descriptions of each AFS. This analysis produced 28 job groups -- the groups and the AFSs within each are listed in Appendix B. Note that extremely small AFSs (fewer than 100 total population) have been omitted because they often represent unique or atypical specialties that do not fit any of the groups (e.g., Seaman -- 5 in the entire Air Force, Gunsmith -- 12 in the entire Air Force).

Occupational Interest Survey Development

Each of the 28 job groups was then given a title and a generic job description that encompassed the majority of the duties performed across the AFSs in the group. The typical environments in which the work is performed and typical job titles were also specified for each job group. A 10-point scale was used to measure an applicant's level of interest in each of the 28 job groups.

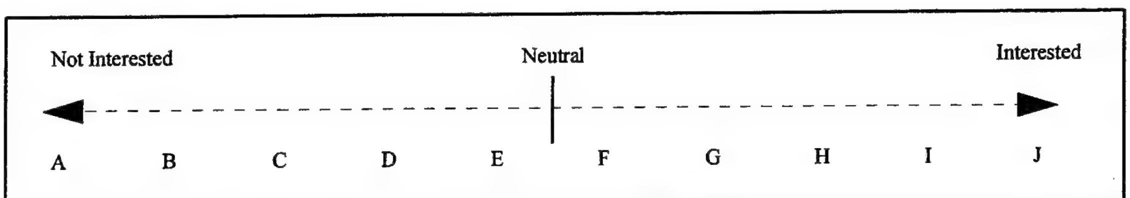

Figure 3. 10-Point Job Interest Scale

The 28 job group descriptions, the rating scale, a set of instructions, and a Privacy Act statement were then assembled, resulting in the instrument contained in Appendix C. A standard scannable answer sheet was used to record the occupational interest responses, along with each respondent's Social Security Account Number (SSAN) so the results could be matched with aptitude data recorded in other files.

The sentence structure and reading grade level of the instructions and the questionnaire were evaluated with RightWriter© to simplify them as much as possible. Except for technical terms contained in job titles, the questionnaire and instructions were appropriate for a ninth grade reading level.

Survey Sample

Since the purpose of the survey was to obtain an estimate of the joint distribution of interest and aptitude in the Air Force *applicant* population, the preferred sample would be one randomly selected from those who have applied for enlistment[4]. This would require sampling the entire DEP population, including those who have not been matched to an Air Force job; however, within the time and resource limits of this project, access to that population was impractical. The most readily accessible subset of the applicant

[4] For the purposes of this project, an applicant is defined as an individual who is sent to a MEPS by an Air Force recruiter for testing and processing.

population was the group of airmen going through Basic Military Training (BMT) at Lackland AFB. This sample is routinely available to the Armstrong Laboratory for experimental testing.

Recruits in BMT, however, do not necessarily represent the occupational interests of the entire applicant population for several reasons. First, they have all been through at least part of the classification process and have been matched to either an aptitude area (MAGE) or to a specific AFS; therefore, their interests may have been affected by the classifiers with whom they have discussed Air Force job opportunities. Also, because they have already been matched, in terms of interest and aptitude, to some Air Force requirement, those applicants with interests and aptitudes that are not compatible with current Air Force needs will not be adequately represented in the BMT population. While recognizing these shortcoming, it was decided to use the BMT population to develop a first version of the model, with the possibility of a wider-ranging survey in the future if the preliminary results are promising.

The occupational interest survey was administered at Lackland AFB to flights of basic trainees (approximately 50 airmen per flight) during November and December 1993. A total of 892 surveys were completed and scanned into a database.

Survey Results and Analysis

Of the 892 surveys obtained from the BMT sample, 94 (10.5 percent) were found to contain incomplete or out-of-range responses (e.g., ratings were missing, or more than 28 ratings were provided, or ratings above "J" were marked). After removing all records with erroneous responses, 798 remained. Of these, 620 were from male airmen and 178 (22 percent) were from female airmen[5]. Mean occupational interest ratings and standard deviations for each of the 28 job groups, by gender and total, are contained in Table 3. The alphabetical rating scale was converted to a numerical scale as follows: A = 0, B = 1, C = 2, ... J = 9.

Significant gender difference existed in the occupational interests of this sample. Using z-statistics for comparisons of means, the male and female mean ratings of all but three of the 28 job groups were significantly different at the .10 level[6]. The three job groups with similar male and female interest ratings were Operations Support Specialist, Intelligence Specialist, and Computer Specialist. Gender differences showed males more interested than females in the mechanical, electronic, operations, and security specialties; and females more interested than males in the clerical, language, communications, and medical specialties.

For each job group, the full rating range (0 to 9) was used. The mean ratings varied from a low of 2.487 to a high of 5.513 with a global mean of 4.017, slightly below the scale mid-point of 4.5. The Aircraft Mechanic group was rated above average (4.766), but the other mechanical groups were rated below average. The aircraft-related electronic job groups were both rated above average. Table 4 below lists the five most popular and least popular job groups.

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[5] During the period October - December 1993, 23 percent of Air Force enlisted accessions were female.

[6] A significance level (alpha) of .10 was be used for hypothesis testing throughout this study.

Table 3. Occupational Interest Survey Descriptive Statistics

Job Group	Males (N=620)		Female (N=178)		Total (N=798)	
	Mean	SD	Mean	SD	Mean	SD
1. Aircraft Mechanic	5.339	3.207	2.770	3.060	4.766	3.349
2. Missile Mechanic	3.647	2.930	1.921	2.552	3.262	2.938
3. Munitions Mechanic	3.558	2.999	1.910	2.569	3.190	2.987
4. Vehicle Operator/Mechanic	3.916	3.058	1.955	2.524	3.479	3.057
5. Facility Support Specialist	2.756	2.692	1.551	2.263	2.487	2.649
6. Operations Clerk	2.795	2.769	4.770	2.963	3.236	2.929
7. Logistics Clerk	2.869	2.678	4.191	2.934	3.164	2.790
8. Finance Clerk	2.679	2.816	4.545	3.103	3.095	2.983
9. Information Clerk	2.426	2.754	4.680	3.000	2.929	2.962
10. Personnel Clerk	2.682	2.699	5.433	3.034	3.296	3.003
11. Aircraft Systems Operator	5.666	3.046	4.972	3.242	5.511	3.102
12. Operations Support Specialist	5.061	2.589	5.067	2.991	5.063	2.682
13. Combat Operations Support Specialist	4.945	3.162	3.921	3.344	4.717	3.230
14. Intelligence Specialist	5.468	3.098	5.669	3.278	5.513	3.138
15. Translator	2.977	3.078	4.556	3.405	3.330	3.220
16. Image Specialist	4.515	2.972	5.483	3.031	4.731	3.010
17. Communications System Operator	3.561	2.705	4.545	2.862	3.781	2.769
18. Computer Specialist	5.073	3.006	5.129	3.003	5.085	3.004
19. Security Specialist	5.311	3.177	4.320	3.225	5.090	3.213
20. Medical Technician	4.776	3.096	6.230	3.321	5.100	3.203
21. Musician	2.676	3.136	3.388	3.398	2.835	3.208
22. Media Specialist	3.521	3.082	5.084	3.304	3.870	3.197
23. Aircraft Electronics Technician	5.332	3.051	2.927	3.114	4.796	3.223
24. Elect Aircraft Support Equipment Tech	5.097	3.017	2.798	3.065	4.584	3.174
25. Missile Electronic Technician	3.944	2.960	2.185	2.534	3.551	2.961
26. General Electronic Equipment Tech	4.502	2.884	2.713	2.872	4.103	2.974
27. Electrical Systems Technician	4.329	2.928	2.258	2.698	3.867	3.003
28. Precision Electronic Equipment Tech	4.489	3.068	2.528	2.823	4.051	3.122

Table 4. Most and Least Popular Job Groups

Most Popular	Mean Rating
Intelligence Specialist	5.513
Air Systems Operator	5.511
Medical Technician	5.100
Security Specialist	5.090
Computer Specialist	5.085
Least Popular	
Logistics Clerk	3.164
Finance Clerk	3.095
Information Clerk	2.929
Musician	2.835
Facility Support Specialist	2.487

Adding Aptitude Data

Aptitude data (i.e., MAGE scores) were added to the survey responses by matching the SSANs from the survey file with the corresponding records on the MEPS AF APPLICANTS/ACCESSIONS MASTER file maintained by the Armstrong Laboratory. This process resulted in a file of 701 records that had complete and valid occupational survey responses and aptitude composite scores. The 97 records that could not be matched with the MEPS file either had miscoded SSANs or were not included in the MEPS data base.

Mapping Job Group Interest to Aptitude/Interest Categories

Once the occupational interest survey responses and individual aptitude composite scores were combined into a single data file with 701 records, the results had to be mapped to the 12 aptitude/interest categories to generate the joint distribution of aptitude and interest (the p_i's) needed in the model. This was done in the following manner:

1. The mapping approach assumed that the interest rating given to a job group on the survey by an individual applied equally to each AFS in that job group (i.e, the job groups were homogeneous with respect to interest). A second assumption was that an individual's interest in one of the 12 aptitude/interest categories was the average of the individual's interest in each of the AFSs that make up the category. These two assumptions, and the mapping of AFSs to both the 28 job groups and the 12 aptitude/interest categories contained in Appendix B, provided a basis for converting survey responses to the 12 categories required by the model.

2. This was done using the following equations, where the JGX values are the individual's interest ratings for each of the 28 job groups (JG1 through JG28) and the weights are the proportion of the total number of AFSs in the aptitude/interest category that are also in the job group. For example, 50 percent of the AFSs that comprised category M2 (10 out of 20) were also AFSs included in Job Group 1 (aircraft mechanic). A table version of this mapping can be found in Appendix E.

M1 Interest Rating = 1.00 (JG3 Interest Rating)

M2 Interest Rating = .50 (JG1 Interest Rating) + .10 (JG2 Interest Rating) + .20 (JG4 Interest Rating) + .20 (JG5 Interest Rating)

M3 Interest Rating = .20 (JG1 Interest Rating) + .60 (JG4 Interest Rating) + .20 (JG12 Interest Rating)

A1 Interest Rating = 1.00 (JG8 Interest Rating)

A2 Interest Rating = .50 (JG6 Interest Rating) + .17 (JG7 Interest Rating) + .17 (JG10 Interest Rating) + .16 (JG17 Interest Rating)

A3 Interest Rating = .57 (JG7 Interest Rating) + .29 (JG9 Interest Rating) + .14 (JG10 Interest Rating)

G1 Interest Rating = .17 (JG8 Interest Rating) + .33 (JG14 Interest Rating) + .17 (JG15 Interest Rating) + .33 (JG22 Interest Rating)

G2 Interest Rating = .02 (JG1 Interest Rating) + .02 (JG6 Interest Rating) + .04 (JG7 Interest Rating) + .10 (JG11 Interest Rating) + .12 (JG12 Interest Rating) + .04 (JG13 Interest Rating) + .06 (JG14 Interest Rating) + .08 (JG16 Interest Rating) + .04 (JG17 Interest Rating) + .08 (JG18 Interest Rating) + .02 (JG19 Interest Rating) +.38 (JG20 Interest Rating)

G3 Interest Rating = .09 (JG5 Interest Rating) + .28 (JG7 Interest Rating) + .18 (JG10 Interest Rating) +.09 (JG12 Interest Rating) +.09 (JG16 Interest Rating) + .18 (JG19 Interest Rating) +.09 (JG21 Interest Rating)

E1 Interest Rating = 1.00 (JG28 Interest Rating)

E2 Interest Rating = .03 (JG18 Interest Rating) + .42 (JG23 Interest Rating) + .23 (JG24 Interest Interest Rating) + .09 (JG25 Interest Rating) + .23 (JG26 Interest Rating)

E3 Interest Rating = 1.00 (JG27 Interest Rating)

Determining the Joint Distribution of Aptitude and Interest

After accomplishing the mapping, each respondent then had an interest rating for each of the 12 aptitude/interest categories. However, not all individuals were qualified for all 12 of the categories. To account for aptitude qualification, each respondent's interest ratings were set to zero in those categories for which the individual did not meet the minimum aptitude requirement, as defined in Figure 2. Each respondent's interest ratings were then divided by the sum of all 12 ratings. This, in effect, distributed each respondent's total interest (conditioned by aptitude) across the 12 categories. The final step was to average the distributions across all respondents to produce the overall joint interest/aptitude distribution (the p_i's) to be used in the model. The resulting joint distribution is shown in Table 5.

Table 5. Joint Distribution of Interest and Aptitude (p_i's)

	Mech	Admin	Gen	Elect
1 - High	.052	.062	.051	.041
2 - Medium	.085	.089	.135	.064
3 - Low	.096	.096	.127	.102

Distribution of Enlistment Requirements (First-Term Force Analysis)

The next step in articulating the recruiting cost model was estimating the N_i's -- the distribution of enlistment requirements across the 12 aptitude/interest categories. This was done by analyzing the jobs normally filled by new airmen, and the aptitudes of the airmen filling those jobs. An extract of the active duty enlisted force file as of the end of FY 93 (30 September 1993) was constructed containing the Control Air Force Specialty Code (CAFSC) and the MAGE aptitude composite scores for each first-term airman (generally those with less than 4 years of service, although some initial enlistment contracts can extend to 6 years). The CAFSC was used since it represents the specialty into which the airman was originally classified, even if he or she is temporarily serving in another specialty.

Distribution of First-Term Jobs

Each CAFSC was mapped to one of the 12 aptitude/interest categories (M1, M2, ..., E3) by checking it against the Air Force Specialty Code (AFSC) prerequisites file used in PROMIS and PACE (Processing and Classification of Enlistees -- the data base and computer programs used to match recruits with jobs while in BMT). This file identifies the aptitude area of the AFSC and the minimum aptitude score required for entry into the AFSC. For AFSCs with dual "and/or" aptitude requirements (e.g., an aptitude minimum of 32 on the A composite <u>and</u> 51 on the M composite; 40 on the A composite <u>or</u> 43 on the G composite), the AFSC was placed into the category with the highest minimum score requirement. This process resulted in 97,717 records distributed by category as shown in Table 6 (the values in parentheses are proportions of the total).

Table 6. Distribution of FY 93 First-Term Jobs

	Mech	Admin	Gen	Elect
1 - High	5,637 (.058)	1,263 (.013)	1,916 (.020)	784 (.008)
2 - Medium	19,836 (.203)	5,315 (.054)	19,476 (.199)	11,909 (.122)
3 - Low	6,989 (.072)	5,330 (.054)	17,630 (.180)	1,632 (.017)

Historical Distribution of Aptitudes Across Jobs

The distribution of first-term jobs by itself does not represent a true requirement because it implies that the Air Force only needs airmen who just meet the minimum aptitude requirement for their job. In fact, a range of aptitudes above the minimum are needed in each AFSC to provide candidates for future supervisory, leadership, and instructor positions where more than the minimum aptitude is required for success. To measure the utilization rates the Air Force has historically experienced, a series of four 2-way distributions (one for each aptitude area) were run against the first-term file extract using the individual's job category for one dimension and their actual aptitude category for the other dimension. The results of the analysis are summarized in Table 7 (the values in parentheses are proportions of total jobs in the category).

Table 7. FY 93 First-Term Utilization Rates

	Mech	Admin	Gen	Elect
Med Diff Jobs with Hi Apt Airmen	15,591 (.786)	4,203 (.791)	10,808 (.555)	9,726 (.817)
Low Diff Jobs with Hi Apt Airmen	4,709 (.674)	4,045 (.759)	5,632 (.320)	1,105 (.677)
Low Diff Jobs with Med Apt Airmen	1,321 (.189)	946 (.178)	10,861 (.616)	326 (.200)

Combining data from Tables 6 and 7 yields the distribution of Air Force enlistment requirements across the 12 categories shown in Table 8. The values in the cells in Table 8 are calculated by adjusting the corresponding values in Table 6 (the figures in parentheses) by the historical first-term utilization rates in Table 7. For example, the value for cell G1 in Table 8 (.188) is equal to the value of the corresponding cell in Table 6 (.020), plus G2 from Table 6 (.199) times the proportion of G2 jobs filled by G1-qualified airmen from Table 7 (.555), plus G3 from Table 6 (.180) times the proportion of G3 jobs filled by G1-qualified

airmen from Table 7 (.320). Within each of the four aptitude areas, the formulas for computing the values in Table 8 are as follows (the subscripts refer to the rows in the tables):

Table 8(1) = Table 6(1) + [Table 6(2) * Table 7(1)] + [Table6(3) * Table 7(2)]
Table 8(2) = [Table 6(2) * (1 - Table 7(1))] + [Table 6(3) * Table 7(3)]
Table 8(3) = Table 6(3) * [1 - Table 7(2) - Table 7(3)]

Table 8. Distribution of Enlistment Requirements (N_i's)

	Mech	Admin	Gen	Elect
1 - High	.265	.097	.188	.119
2 - Medium	.057	.021	.200	.026
3 - Low	.010	.003	.012	.002

Model Estimates of Recruiting Difficulty

Recall from equation (2) that the ratio (N_i/p_i) can be interpreted as a measure of the difficulty in filling the requirements for people of type i. Tables 5 and 8 provide estimates of the values for p and N for each of the 12 aptitude/interest categories (the i's), so a recruiting difficulty index for each category, shown in Table 9, can now be computed. According to these indices, the most difficult categories to fill are the high aptitude requirements (M1, G1, E1, and A1), followed by the medium aptitude requirements (G2, M2, E2, and A2), with the low aptitude requirements being the easiest to fill. Within each aptitude level, the mechanical and general jobs are more difficult to fill than the admin and electronic jobs. This pattern is driven primarily by the very high rates at which the Air Force has historically utilized high aptitude airmen (Table 7), which pushes the enlistment requirements toward the higher aptitude levels. The most difficult category (M1) is 255 times more difficult to fill than the easiest category (E3), i.e., it should take 255 times as many applicants to fill all the M1 requirements as it takes to fill all the E3 requirements.

Table 9. Model Estimates of Recruiting Difficulty

Category	N_i	p_i	Recruiting Difficulty Index (N_i/p_i)
M1 - High Mech	.265	.052	5.10
M2 - Med Mech	.057	.085	0.67
M3 - Low Mech	.010	.096	0.10
A1 - High Admin	.097	.062	1.56
A2 - Med Admin	.021	.089	0.24
A3 - Low Admin	.003	.096	0.03
G1 - High Gen	.188	.051	3.69
G2 - Med Gen	.200	.135	1.48
G3 - Low Gen	.012	.127	0.09
E1 - High Elect	.119	.041	2.90
E2 - Med Elect	.026	.064	0.41
E3 - Low Elect	.002	.102	0.02

VALIDATION OF RECRUITING DIFFICULTY INDICES

Recruiting Difficulty Survey

To see how closely the model's estimates of recruiting difficulty matched the subjective judgments of experienced Air Force recruiters regarding the difficulty of recruiting to fill the 12 categories of Air Force enlisted jobs, a recruiting difficulty survey was designed and administered.

Survey Development

Three alternative scales were considered for collecting the recruiting difficulty data. The first scale listed all possible pairs of categories and asked recruiters to select the more difficult category to recruit from each pair (pairwise comparisons). The second scale asked recruiters to simply rank order the categories in terms of recruiting difficulty; the third instrument used a recruiter effort scale to indicate the difficulty of filling jobs from each category. The experimental versions of these forms used 16 aptitude/interest categories rather than the 12 currently in use. One result of the pilot test described below was the reduction in the number of categories from 16 to 12. Rationale for this change was also described previously in the section on Selection of Recruit Categories.

Pilot Test

All three forms were tried out on a sample of five recruiters at Headquarters Recruiting Service. All five recruiters (a master sergeant and four technical sergeants) had prior LNCO experience. Each recruiter filled out all three forms in mixed order. After completing the forms, a feedback session was held to obtain their comments and recommendations. Because it involved 120 choices, the paired comparison approach was by far the most difficult and time consuming for the recruiters, taking 10-15 minutes to fill out. The rank order form and the recruiter effort scale only took 2-3 minutes. The recruiters felt that 16 categories

were too many. They could not differentiate in their minds between some categories and recommended the 12 category structure currently in use.

The recruiting difficulty indices produced by the three different measurement instruments were remarkably similar. The indices for the paired comparison data for each respondent were calculated by adding up the number of times each category was selected as the more difficult of a pair. Since each category appeared 15 times in the choice set, the possible values for the index ranged from 0 (least difficult) to 15 (most difficult). An overall index for each category was computed by averaging across the five respondents.

The rank order information was converted from a scale of 1 (most difficult) to 16 (least difficult) to a 15 to 0 scale (to match the pairwise comparison scale) by subtracting each rank order position from 16. Again, overall indices for each category were computed by averaging across the five recruiters. The recruiter effort scale used in the tryout ranged from 1 (maximum effort) to 7 (minimum effort). For comparison purposes, these responses were converted through a linear transformation ($Y = -2.5X + 17.5$) to the same 15 to 0 scale produced by the other two instruments. Correlations were run to determine the degree of agreement among the recruiting difficulty indices generated by the three forms. They are as follows:

Pairwise vs. Ranking:	$r = .84$
Pairwise vs. Effort Scale:	$r = .92$
Ranking vs. Effort Scale:	$r = .80$

Based on the results of the pilot test, a recruiting difficulty data collection instrument using a simple 7-point difficulty scale to rate each of the 12 categories was selected -- a copy of the instructions and the survey form is included in Appendix D.

Survey Sample

Since production recruiters are not directly involved in the person-job-match process and may not have first-hand knowledge of which categories of jobs are hardest to fill, Headquarters Recruiting Service personnel recommended that the sample be limited to flight supervisors and liaison NCOs (LNCOs) serving in the MEPS. At the time the survey was administered there were approximately 360 flight supervisors and LNCOs; surveys were sent to all 360 in November 1993.

Survey Results and Analysis

Of the 360 surveys mailed, 213 were returned for a 59 percent response rate. Only one rating out of a possible 2556 was missing from the data set. Rater identification data include recruiting group and squadron (one missing), pay grade (nine missing), assignment type (Flight Supervisor or LNCO, 10 missing), and months of recruiting experience (seven missing). Responses were received from 28 of the 29 recruiting squadrons; they were distributed by recruiting group as shown in Table 10.

Table 10. Recruiting Difficulty Survey Responses by Group

Group	# Sqdns	# Responses	Responses per Sqdn
360th	7	51	7.3
367th	8	64	8.0
369th	8	55	6.9
372nd	5	42	8.4
Total	28	212*	7.6 (range: 3 to 15)

* One of the 213 responses was missing group/squadron identification

Flight Supervisors and Liaison NCOs are represented nearly equally in the data set, predominately in grades E-5, E-6, and E-7. Their responses by grade and position are in Table 11.

Table 11. Recruiting Difficulty Survey Responses by Grade and Position

	Flt Sup	LNCO	Unk	Total
E-4	0	1	0	1
E-5	0	37	2	39
E-6	25	39	0	64
E-7	79	12	3	94
E-8	6	0	0	6
Unk	4	0	5	9
Total	114	89	10	213

According to the survey, the most difficult jobs to fill are G1, M1, M3, and E1 followed by G2, E2, M2 and G3/E3 (tied). The easiest categories to fill are A1, A2, and A3. Within each aptitude area the recruiting difficulty ratings follow the aptitude levels (i.e., higher aptitude jobs are harder to fill than lower aptitude jobs) except in the mechanical area, where the low aptitude jobs are rated harder to fill than the medium aptitude jobs. The mean ratings for each of the categories are in Table 12.

Table 12. Survey-Based Recruiting Difficulty Ratings

	Mech	Admin	Gen	Elect	Avg
1 (High Apt)	5.42	2.75	5.74	4.37	4.57
2 (Med Apt)	3.26	2.14	3.46	3.30	3.04
3 (Low Apt)	4.45	1.94	3.22	3.22	3.21
Avg	4.38	2.28	4.14	3.63	3.61

In Table 13, the 12 job categories are rank ordered by mean recruiting difficulty rating (high to low) and the differences in means between adjacent categories are tested by computing z-statistics and rejecting the hypothesis that adjacent means are equal if $|z| >= 1.645$ at the .10 level.

Table 13. Clustering Categories Based on Recruiting Difficulty

Category	Mean Recruiting Difficulty Score	z	Significant Difference?
G1	5.74	-	---
M1	5.42	2.495	yes
M3	4.45	6.825	yes
E1	4.37	0.466	no
G2	3.46	5.456	yes
E2	3.30	1.038	no
M2	3.26	0.256	no
G3	3.22	0.260	no
E3	3.22	0.000	no
A1	2.75	3.030	yes
A2	2.14	3.999	yes
A3	1.94	1.536	no

Based on these results, the 12 job categories can be clustered into six difficulty levels (Figure 4) in which the differences within clusters are not significant, while the difference between clusters are significant.

Most Difficult:	G1				
	M1				
	M3,	E1			
	G2,	E2,	M2,	G3,	E3
	A1				
Least Difficult:	A2,	A3			

Figure 4. Recruiting Difficulty Clusters

Comparison with Model Estimates

Table 14 compares the recruiting difficulty indices generated by the model (from Table 9) with those derived from the recruiter survey (from Table 12).

Table 14. Comparison of Model-Based and Survey-Based Recruiting Difficulty Indices

Category	Model-Based Index (Rank)	Survey-Based Index (Rank)
M1	5.10(1)	5.42(2)
M2	0.67(6)	3.26(7)
M3	0.10(9)	4.45(3)
A1	1.56(4)	2.75(10)
A2	0.24(8)	2.14(11)
A3	0.03(11)	1.94(12)
G1	3.69(2)	5.74(1)
G2	1.48(5)	3.46(5)
G3	0.09(10)	3.22(8.5)
E1	2.90(3)	4.37(4)
E2	0.41(7)	3.30(6)
E3	0.02(12)	3.22(8.5)

The correlation (r) between the two sets of indices is .78, which is significantly different from zero at the .10 level. Both techniques identify G1, M1 and E1 in the top third of their respective difficulty rankings, and G2, E2, and M2 are in the middle third on both scales. The largest differences between rankings on the two scales are for categories M3 and A1. The model ranked A1 in the top third and M3 in the bottom third, while the survey reversed their positions. Overall, the degree of agreement between the two techniques is surprisingly high, considering the differences in how the estimates were derived.

COST ANALYSIS

The recruiting cost model, as developed so far, produces estimates of the number of applicants required to obtain enough enlistments to fill a given set of Air Force requirements. The number of applicants required can be viewed as a measure of recruiting difficulty, which by itself can serve as a useful metric for many studies using the model. However, there may be situations were an actual dollar estimate is a desired output from the model. Therefore, the purpose of this section is to develop an equation relating the number of applicants required to the cost of recruiting those applicants (the term c in Equation (2)).

One of the primary objectives of this study was to develop a cost model that reflects the reality of Air Force recruiting operations. Classical econometric studies of recruiting (e.g., Daula & Smith, 1985; Dertouzos, 1985) developed supply models and production functions that related outputs (enlistments) to resource inputs (e.g., number of recruiters, enlistment incentives, advertising), and recruiting market conditions (e.g., relative military/civilian wages, youth unemployment, etc.), by assuming that at least a significant portion of the enlistment process is supply constrained. In other words, for a given set of market conditions, a Service must increase the resources dedicated to recruiting in order to increase the number of high quality enlistments. This assumption does not appear to hold for the Air Force, at least over the range of resources and enlistments observed in recent years. This is evidenced by the fact that an 18 percent cut in the number of production recruiters and a 21 percent cut in the overall NPS recruiting budget from FY 90 to FY 93 resulted in no reduction in the number of applicants processed and only an 8 percent drop in the number of AFQT Category I and II applicants (see Table 15). This phenomenon cannot be explained by an

increase in military pay relative to civilian pay (military pay has declined relative to civilian pay since 1982 (Maze, 1994)), or an increase in propensity to enlist in the Air Force (which has also declined steadily since 1986 (Wilson, Nieva, Kolmstetter, & Greenlees, 1993)).

Table 15. FY 90-93 NPS Cost, Applicants, and Recruiters

	FY 90	FY 91	FY 92	FY 93
Total NPS Recruiting Cost[1]	\$116.7M	\$110.0M	\$105.2M	\$101.9M
New NPS Applicants Processed[2]	65,265	63,450	65,622	64,586
Cat I-II % of Applicants[2]	45.4	44.5	44.4	42.2
Avg Number of Prod Recruiters[3]	1206	1083	1043	991

1. Total NPS recruiting costs obtained from Recruiting Service budget office.
2. Numbers and AFQT categories of applicants obtained from analysis of MEPS files.
3. Number of assigned production recruiters, by month, obtained from Recruiting Service Market Analysis Branch

In fact-finding discussions with Recruiting Service budget personnel, they emphasized that the bulk of the Air Force recruiting budget is essentially fixed in any given year, determined by budget and program negotiations, not by the number of enlistments required or the recruiting market. The largest component of this fixed cost is the number of production recruiters authorized, since this determines the military pay cost (the largest single component in recruiting cost) and all of the other costs to support a recruiter in the field (e.g., office space, utilities, travel, communications, supervision). Several factors unrelated to enlistment goals are considered in sizing the Air Force recruiting force. One important factor is geographic and socioeconomic representation. If the Air Force is to represent a cross-section of American society, it must maintain a recruiting presence in all geographic regions and in both urban and rural areas, even if this requires more recruiters than the minimum necessary to fill enlistment quotas. Another factor is surge capability. Even though enlistment goals are currently quite low, a military crisis or change in national strategy could quickly increase the demand for new recruits. Since an effective recruiting force cannot be created overnight, it is prudent for the Air Force to maintain more recruiters than required to fill current (low) enlistment needs.

For these reasons, we believe that the most realistic specification of an Air Force recruiting cost model is one in which the number of recruiters is an input to the model, rather than an output. In this formulation, all the costs of <u>prospecting</u> for applicants in a particular fiscal year are loaded on the average number of recruiters supported that year, while the <u>processing</u> costs are calculated as a function of the number of applicants required to meet enlistment goals that year, determined from the distribution of aptitude and interest among the applicants and the mix of jobs to be filled. The form of the cost function is as follows:

$$C_t = (R_t * C_r) + (A_t * C_a) \tag{3}$$

Where: C_t = Total cost of recruiting during time period t
R_t = Average number of recruiters assigned during time t

C_r = Cost per recruiter
A_t = Applicants processed during time t
C_a = Cost per applicant processed

A model of this form cannot be used to estimate the number of recruiters required to achieve a given number of enlistments because the underlying assumption is that the number of recruiters required is determined by factors other than just enlistment goals, at least over the range of goals (30,000 - 36,000) experienced in the past four years. This does not imply that enlistment goals play no role in sizing the recruiting force; if the goals significantly increased or decreased, the number of recruiters would have to be adjusted accordingly.

Historical Cost, Recruiter, and Applicant Data

The first step in estimating the parameters of equation (3) was to obtain historical NPS enlisted recruiting cost data from Recruiting Service. Until recently the services have been unable to separate their overall recruiting costs into the various categories of recruiting -- prior service, NPS, officer, and health professions -- because the recruiting missions are so highly integrated. In the Air Force, individual recruiters may work several categories simultaneously, and all of the recruiting management and overhead structure (including general awareness advertising) supports all of the categories at the same time. The Air Force has been working for several years with the other services and DoD to develop a methodology for apportioning overall recruiting costs to the various categories. Unfortunately, data from this methodology are only available for the past four fiscal years (90-93); prior to FY 90, only aggregate recruiting costs are available. Furthermore, the NPS-specific cost data are only available for entire fiscal years -- they are not maintained on a monthly or quarterly basis nor are they maintained at the squadron or group level.

The component of recruiting cost that does vary with the size of the recruiting mission is a function of the number of applicants processed. Counts of the number of NPS applicants processed during FY 90-93 were obtained from the MEPS AF APPLICANTS/ACCESSIONS MASTER file maintained by the Armstrong Laboratory. Each time an individual visits the MEPS (for initial testing, retesting, clearing of disqualification factors, or to ship to BMT), a new record is entered into this file. Therefore, to preclude double counting applicants, only the first occurrence of an individual SSAN was counted. Applications from FY 89 were screened to avoid counting occurrences in FY 90 that were not actual first occurrences. AFQT scores were also recorded for each applicant. The resulting counts of applicants processed and percentages in AFQT categories I and II are shown in Table 15.

Cost Equation

Using the data from Table 15, a regression line was fit through the four data points (FY 90-93), using applicants processed and average number of production recruiters as the independent variables, and total NPS recruiting cost as the dependent variable. To be consistent with the formulation in equation (3), the intercept was forced to zero to load all of the cost variance on the two independent variables.[7] This produced equation (4), with an R^2 of .95 and an average absolute prediction error for FY 90-93 of $1.95M, or 1.8 percent of the average actual cost over the period:

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[7] Running the regression without forcing the intercept to zero produces an equation with a higher R^2 (.998) but with a constant term of about $93 million and a negative coefficient on applicants (-$950). The coefficient on recruiters stays about the same ($71,054).

$$\textit{NPS Recruiting Cost (\$M)} = \$71{,}194 \times \textit{number of recruiters} + \$486 \times \textit{number of applicants processed} \quad \mathbf{(4)}$$

According to this relationship, during the period FY 90-93 it cost an average of $71,194 to keep a production recruiter in the field for a year, plus another $486 to process each applicant. If more data points were available it might be possible to refine this equation by including other factors that influence costs, such as the ratio of recruiters to recruiting offices.

Model Integration

All of the relationships and rates developed in this study have been integrated into a simple Lotus © spreadsheet to facilitate validation and policy analysis; a copy of the spreadsheet is at Appendix F. The spreadsheet contains the joint distribution of aptitude and interest from Table 5, the distribution of first-term Air Force jobs from Table 6, and the historical utilization rates from Table 7.

The spreadsheet takes a user-input enlistment requirement, distributes that requirement across the 12 job categories, and adjusts the distribution to account for utilization, thus calculating an enlistment requirement for each of the 12 categories. However, more enlistment contracts must be signed than are needed to meet enlistment requirements because a proportion of people who sign contracts and enter the DEP never actually enter BMT; therefore, the number of contracts needed to achieve the required number of enlistments in each category must be inflated to account for a user-input DEP attrition rate. The spreadsheet then uses the joint distribution of aptitude and interest to calculate the number of applicants required to obtain the required number of contracts in each category.

Air Force recruiters, however, do not process every applicant (in fact, they are quite selective about whom they send to the MEPS for processing), so the applicant requirement is factored down by a user-input percent of applicants processed. The spreadsheet then calculates recruiting costs using equation (3) with a user-input number of recruiters and the model's calculation of the number of applicants processed.

The spreadsheet also calculates a marginal cost per enlistment in each of the 12 categories by multiplying the number of processed applicants required in each category by the average cost per applicant processed ($486) and then dividing the product by the number of enlistments obtained from the applicants. These are the cost factors that could be used in a cost/performance tradeoff model such as the one developed by Faneuff et al. (1990).

The model was then calibrated to replicate FY 93 (the most recent data available). This was done by entering the total number of enlistments actually achieved in FY 93 (31,500), the actual DEP attrition rate experienced (12 percent, obtained from Recruiting Service), and the average number of production recruiters assigned during the year (991), and letting the spreadsheet calculate the total number of applicants required to obtain that many enlistments (195,300). The percent of applicants processed was then adjusted to replicate the number of applicants actually processed in FY 93 (64,458) -- this value turned out to be .33 (64,458 ÷ 195,300). While individual squadrons maintain records of the number of applicants sent on the MEPS for processing, the data are not centrally maintained for all of Recruiting Service. Because this factor is difficult to validate empirically, it is developed in the model as a calibration factor. However, processing one out of three applicants seemed reasonable based on discussions with recruiters.

To check the validity of the model for years other than the calibration year (FY 93), it was used to estimate the number of applicants processed in FY 90, 91 and 92 for comparison with the actual numbers processed in those years. The results are in Table 16. The average absolute error is about 8 percent over these three years. The error could be due to several factors, including differences in the interests and aptitudes of the applicant populations, differences in the mix of enlistment requirements, differences in the utilization of high aptitude airmen, differences in DEP attrition rates, and/or differences in the percent of applicants processed (all of these factors are assumed to be constant over the three years in estimating the number of applicants processed each year) and other factors not in the cost model.

Table 16. Estimated vs. Actual Applicants Processed

	FY 90	FY 91	FY92
Actual Number of Enlistments	36,000	30,000	35,100
Model Estimate of Applicants Processed	73,656	61,380	71,815
Actual Number of Applicants Processed	65,265	63,450	65,622
Error	+8,391	-2,070	+6,193
Error/Actual	+.13	-.03	+.09

CONCLUSIONS AND APPLICATIONS

Conclusions from the Present Study

The hybrid approach to modeling Air Force NPS recruiting cost proposed in this study appears to produce a reasonably accurate macro-level model that meets all of the objectives of the study. The cost accounting approach generated estimates of recruiting difficulty for the various job categories that were consistent with the subjective judgments of experienced recruiters (r = .78). The statistical cost equation (Eq. 4) produced total cost estimates (given a number of recruiters and number of applicants processed) that were less than 2 percent of actual costs over the period (FY 90-93) used to estimate the equation's parameters (R^2 = .95). While this approach is unprecedented in analyzing military recruiting cost, we believe it has promise as an analytical framework.

Applications to Recruiting Policy Analysis

Insight into several interesting personnel policy issues could be enhanced through the use of the model. Some examples are:

1. What is the impact on recruiting difficulty and cost of changing Air Force job requirements? As AFSs are added, deleted, combined, or modified they change the Air Force's demand for individuals with certain qualifications and interests. The model could be used to quantify the impact of those changes. The model could identify the recruiting cost drivers (e.g., high aptitude mechanical and general jobs), for further study. If the demand for these jobs can be reduced, significant savings in recruiting costs could be achieved.

2. Given a set of enlistment requirements, what job categories will be most difficult to fill? The model could be used to anticipate recruiting problems and assist in the allocation of resources to

mitigate the problem. The information could also be included in recruiter training programs and in the internal Recruiting Service recruiter reward program.

3. What is the cost to the Air Force of recruiting people who have aptitude levels significantly above the minimum required for their jobs? This information could be combined with other research on productivity to calculate both the cost and benefits of having such a highly-qualified force.

4. What would be the cost to the Air Force of recruiting different gender mixes? Except for a small number of male-only jobs, the Air Force does not currently manage its enlisted force gender mix. This free-flow approach produces enlistment cohorts that are generally around 25 percent female (first half of FY 94). Because male and female applicants have substantially different aptitude and interest distributions, the model could be used to estimate the change in cost resulting from a deviation from the free-flow gender mix. By developing aptitude/interest distributions by racial/ethnic groups, the same analysis could be performed to estimate the costs of recruiting higher or lower racial/ethnic mixes.

5. What are the recruiting cost savings that could be achieved by altering the aptitude/interest distribution of the applicant population? It might turn out that the cost of targeted enlistment bonuses or other recruiting incentives required to attract a higher proportion of individuals with high mechanical aptitude and interest would be less than the cost of recruiting them under the current "job neutral" approach.

RECOMMENDATIONS FOR FURTHER WORK

Recommendations to Improve the Existing Methodology

The most significant improvement to the existing model would be administering the occupational interest survey to a sample that is more representative of the applicant population. This would entail collecting data from a random sample of individuals who have taken the ASVAB but who have not yet been processed for Air Force enlistment. This would produce a joint aptitude/interest distribution for use in the model that is less biased by Air Force requirements. The logistics of such a survey would be formidable, but given the promising results obtained so far, the effort would be worthwhile.

A revision to the occupational interest survey to estimate the effects on interest of grouping specialties into open aptitude index (open AI) enlistments should also be considered. As currently structured, the survey measures interest in 28 fairly specific groups of jobs. In reality, the Air Force groups about half of its enlistment requirements into the four broad MAGE aptitude categories called open AI enlistment. Recruits who enlist into one of these categories do not receive their actual specialty assignment until the end of BMT; therefore, accepting an open AI enlistment entails a certain amount of risk on the part of the recruit, which might make some open AI enlistments less attractive than specific specialty enlistments (called Guaranteed Training Enlistment Program (GTEP) enlistments). Adding the open AI categories to the survey would provide data to estimate the level of interest in open AI enlistments among applicants. The model could then be modified to examine the cost implications of varying the mix of open AI and GTEP enlistments being offered by the Air Force.

The model might also benefit from additional study of the 12 aptitude/interest categories. The distribution of jobs across the current categories is far from symmetrical -- the first-term populations range from nearly 20,000 in some categories to less than 1,000 in others. Also, the range of aptitudes varies widely from category to category (e.g., the middle category is only 4 percentile aptitude composite points wide in the electronic area but 25 percentile points wide in the general area). If the break-points between categories were set to divide the number of jobs in each aptitude area into more equally-sized categories, the historical utilization rates in Table 7 might not be so high. Unfortunately, the electronic area presents a problem because over 60 percent of all first-term electronic positions require the same minimum score (E67).

As Air Force Recruiting Service accumulates more NPS-specific cost data, the cost equation in the model should be reestimated. With more data points it might be possible to include other variables in the equation to improve the prediction of fixed and variable costs. For example, fixed cost might be better estimated from the number of production recruiters <u>and</u> the ratio of recruiters to offices. Variable costs might be a function of not only the number of applicants processed but also the average number of visits to the MEPS per applicant.

Any change to the model that affects its estimates of recruiting difficulty, such as revised category definitions or a revised joint aptitude/interest distribution, should be validated with a revised recruiting difficulty survey that uses the same structure.

Recommendations to Extend the Existing Methodology

The model could be extended to permit analysis of the cost implications of varying gender and racial/ethnic mixes by including sex and race/ethnicity as variables in the joint aptitude/interest distribution development process. The model could then be modified to estimate the number of applicants required to meet enlistment requirements using different gender and racial/ethnic mixes.

The inclusion of minimum enlistment standards might also be considered as an extension of the model. Over the years the Air Force has experimented with different minimum standards, at one time requiring a minimum score on the ASVAB general (G) composite plus a minimum sum of the four composites (MAGE). More recently the Air Force has required a minimum AFQT score of 40, which was raised in FY 94 to 45. Raising or lowering the minimum enlistment standard should have an effect on recruiting costs by increasing or decreasing the number of applicants required to enlistment requirements. A conceptual model of the effects would have to be developed and data collected to quantify the cost impacts.

As currently structured, the model implicitly assumes that enlistment requirements in each of the 12 job categories are all equally proportional to the number of first-term positions in the category. If, however, attrition rates (from BMT, technical training, and the first-term) vary across the categories, then the assumption is violated. The model could be extended to incorporate first term attrition when computing the enlistment requirements from the distribution of first-term positions. In other words, a category that makes up 10 percent of all first-term positions might require more than 10 percent of the enlistments each year if it experiences higher than average attrition losses.

The model is presently implemented in a simple spreadsheet. The implementation could be extended to a more sophisticated, user-friendly Decision Support System (DSS) that would facilitate data input and multiple-scenario analyses. Currently, if an analyst wants to evaluate the impact of changing the joint

aptitude/interest distribution, he or she must manually adjust the proportions in the spreadsheet, taking care to ensure that they always sum to one (i.e., if the proportion of applicants qualified and interested in M1 jobs is increased, what other categories must be decreased, and by how much?) An alternative with the present spreadsheet would be to manually increase the <u>number</u> of enlistments required in a particular category to see what effect it has on cost; however, doing so erases the (somewhat complex) formula in that category's enlistment requirement cell, so the analyst must be careful not to replace the basic spreadsheet with the modified version, or the formula will be lost. The spreadsheet can also run only one scenario at a time; the analyst must manually record the measure of merit of interest for each set of input conditions because they are overwritten each time the inputs are changed. A software shell could be built to facilitate these analyses, keep track of multiple run results, and display the results graphically or statistically.

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APPENDIX A

ANNOTATED BIBLIOGRAPHY

Annotated Bibliography

Hosek, J.R., & Peterson, C.E. (1990). Serving her country: An analysis of women's enlistment - interim report (RAND-R-3853-FMP). Santa Monica, CA: Rand Corporation.

Data from a 1979 Department of Defense survey of enlistees and the 1979 wave of the National Longitudinal Survey of Youth Labor Force Behavior were used to examine the factors affecting the flow of new women recruits. The analysis modeled both individual willingness to enlist and the allocation of recruiter effort to enlist women and other groups. The results suggest that there are strong similarities between men and women in the factors influencing their enlistment decisions.

Crosbie, M.K. (1989). Positive propensity and navy enlistment. Unpublished master's thesis. Monterey, CA: Naval Postgraduate School.

This study examined the process used to estimate the military enlistment behavior of young men, and sought to develop measures to improve the process. Enlistment intention was quantified through the construction of two separate propensity measure, the percent positive propensity (PPP) and the Navy propensity index (NPI). These measures were included as explanatory variables in Navy Recruiting Command's current enlistment prediction model, and this model was in turn regressed upon net enlistment contract data. The study compared model performance and forecasting accuracy with and without each of the propensity variables, and examined positive enlistment propensity itself at the regional and local levels. The main conclusions of the study were: (1) weighted propensity should be the value of choice when using YATS II data to estimate propensity measures; (2) net contract data should be the preferred form for use in forecasting enlistments; (3) there has been a definite decrease in nationwide positive propensity during the period of 1983-1987; (4) there is significant regional variation in the predictive accuracy of the current Navy enlistment model; and (5) residual analysis of positive propensity indicates that much of the variation in propensity is explained by other significant explanatory variables, especially local unemployment. The degree to which other factors explain propensity reduced its effectiveness as an explanatory variable in enlistment forecasting models.

Orvis, B.R., Gahart, M., & Hosek, J.R. (1989). Predicting enlistment for recruiting market segments - Interim Report (RAND-N-2852-FMP). Santa Monica, CA: Rand Corporation.

This study examined the relationships between geodemographic information and individual (micro) models of enlistment decision-making. Although geodemographic systems can identify groups with varying enlistment rates, they provide limited information on the factors underlying enlistment. Given the apparent advantages of the micro models, the authors undertook to determine whether differences in enlistment rates among the geodemographic groups were attributable to the types of factors included in the micro models. They found that including geodemographic information in the individual-level models improved the prediction of enlistment decision-making and the factors predicting enlistment varied by geodemographic groupings helping distinguish areas with different enlistment rates. These factors could be used in efforts such as targeting the mailing of recruiting literature and allocating recruiters or recruiting goals. At the same time, the authors found that enlistment decision-making micro models captured much of the same information. Finally, the research showed that the micro models were superior to the geodemographic information in predicting individuals' enlistment decisions and that the inclusion of geodemographic information in the micro models had little meaningful impact on enlistment behavior predictions.

Generazio, H. (1989). Analysis of first-term attrition of non-prior service high-quality US Army male recruits - final report. Cambridge, MA: Operations Research Center, Massachusetts Institute of Technology.

This study estimated an individual's probability of first-term attrition in terms of certain characteristics at time of enlistment. The main technique was logistic regression modeling, which was applied to data pertaining to the high-quality male population of the US Army FY84 NPS accession cohort (high-school graduates who scored 50% or higher on the Armed Forces Qualification Test (AFQT)). The results showed the significant characteristics were age, level of education, aptitude test score, and entry status (with or without a waiver). Age and entry status were positively correlated with the rate of first-term attrition. Conversely, education and aptitude test score were negatively correlated. The recruit also was in a higher risk category for first-term attrition if he or she entered the Army with a waiver. The better educated the recruit, the less likely the person was to drop out.

Cooke, T.W. (1988). Recruiting resources and policies - final report (CRM-88-27). Alexandria, VA: Center for Naval Analyses.

The Recruiting Resources and Policies Study addressed the issue of managing enlisted recruiters more cost effectively to provide the needed quantity and quality of recruits. This was done by examining geographic variation in enlistment goals, recruit production, and recruiter incentives. This research memorandum summarized the study and highlights the major policy implications.

Dertouzos, J.N. (1989). Effects of military advertising: Evidence from the advertising mix test - interim report (RAND-N-2907-FMP). Santa Monica, CA: Rand Corporation.

Advertising is one of the central recruiting tools used by the military services in support of the all-volunteer force. This note analyzed the effects of advertising on recruiting, providing quantitative estimates of the relative effectiveness of Army, Navy, Air Force, Marine Corps, and joint advertising programs. The findings indicated that, in general, the services gain enlistments from additional advertising, and the gains of any one branch did not seem to come at the expense (in terms of lost recruits) of any other. Not only were there no important interservice competitive effects of advertising, but the advertising done by a service apparently conferred important benefits on the other branches as well. Consequently, both service and joint advertising appeared to be powerful tools to help meet the recruiting requirements of the all-volunteer armed forces.

Nelson, A. (1988). Delayed Entry Program (DEP) loss behavior - final report (ARI-TR-823). Alexandria, VA: Army Research Institute for the Behavioral and Social Sciences.

Losses from the DEP are becoming an increasing problem. This research examined the problem of losses from the DEP by both a macro and micro perspective. First, an aggregate item series model was specified and estimated to determine those factors affecting DEP loss trends. A microdata model that used a binary logistic regression approach to examine individual characteristics, enlistment policies, and environmental conditions affecting the probability of DEP loss was then estimated. From this research, high-risk DEP loss groups were identified.

Wilson, M.J., & Perry, M.S. (1988). Career decision survey: Modeling for the Army enlistment decision - final report (ARI-TR-814). Alexandria, VA: Army Research Institute for the Behavioral and Social Sciences.

This technical report documented results from the Career Decision Survey. This survey was developed as a theory-based instrument designed to validate an application of Fishbein and Ajzen's (1975) psychological theory of reasoned action. As applied to career choice, this theory hypothesizes a direct relationship between the beliefs youths have regarding a particular career choice and their attitude toward the career. This attitude, in turn, directly influences intention to pursue the career. In addition, the theory states that career intentions are strongly influenced by the opinions of significant social influences (e.g., parents). Findings validated and supported the adoption of this theory as a useful perspective for analyzing Army enlistment intentions. Using individual respondent beliefs and perceptions alone, this model explained between 46% and 61% of the observed variance in career choice intentions. That is, using a relatively small number of questions that asked youths about their beliefs and opinions and those of persons important to them, the models were able to very accurately predict career intentions.

Dicks, D.A. (1988). Longitudinal analysis of intentions to enlist: Impact on subsequent enlistments and performance of US Marines. Unpublished master's thesis. Monterey, CA: Naval Postgraduate School.

This study examined the relationship between the surveyed intentions of young men to join the military and their actual enlistment behavior. Of specific concern was how knowledge of this relationship might benefit the US Marine Corps in achieving cost-effective management of recruiting resources. A review of selected literature examined the use of an intentions variable in manpower forecasting models as well as some of the major research efforts involving surveyed intentions. The analysis used a longitudinal data base, created by merging responses from the 1976-1983 Youth Attitude Tracking Study (YATS) with Defense Manpower Data Center (DMDC) cohort files, to examine the connection between an individual's self-stated propensity to enlist and his subsequent behavior. The analysis also attempted to describe selected characteristics of individuals who joined the military -- including demographic variables, quality indicators, and measures of performance -- on the basis of their YATS response. There was no conclusive evidence of major differences in the characteristics of enlistees who were initially positive or negative toward joining the military. However, the results of the study did suggest that different combinations of intentions and demographic characteristics may lead to different patterns of enlistment behavior.

Lewis, J.M. (1987). Examination of the influence of environmental factors on recruiting category I-IIIA males. Unpublished master's thesis. Monterey, CA: Naval Postgraduate School.

This study examined the influence of environmental factors on recruiting Category I-IIIA males for the US Army. Econometric modeling using regression analysis was used to estimate the determinants of the supply of recruits. Four models were developed from the cross-sectional time-series data and comparisons of the elasticities of the independent variables were given. The four models were Ordinary Least Squares, Instrumental Variable Estimation, Instrumental Variable Estimation with AR(1), and Fixed Effects. Following a discussion on how the data were collected over a four year period on a monthly basis for each of the Army's fifty-five recruiting battalions (except Puerto Rico), each model was specified and the possible violations of the basis assumptions of linear regression discussed. Results of each model were presented and interpreted in terms of resource allocation and policy implementation.

Faires, J.E. (1986). Model for and method of predicting high quality Army enlistment contracts. Unpublished master's thesis. Monterey, CA: Naval Postgraduate School.

The thesis developed the framework for a parsimonious linear statistical model of quality enlistment contracts for the US Army. Analysts at US Army Recruiting and Deputy Chief of Staff for Personnel needed such a model to perform quick response analysis to 'what if' questions. In order to facilitate further model enhancement and use, it was developed in step-by-step fashion. The author used a 'walk through' approach and thoroughly discussed the assumptions, procedures and analytical tools that were utilized in the model development. This approach was specifically requested by the Army analysts at USAREC.

Brown, C. (1984). Military enlistments: What can we learn from geographic variation - final report (ARI-TR-620). Alexandria, VA: Army Research Institute for the Behavioral and Social Sciences.

This study measured the effects of economic factors on Army enlistments of non-prior-service high school graduates. The author used a multiple-regression, pooled cross-section/time-series model to measure Army enlistment by mental category. He concluded that unemployment, pay, and the number of Army recruiters were important variables in the enlistment decision.

Bicaksiz, A. (1992). PC-based model for estimating regional recruit markets. Unpublished master's thesis. Monterey, CA: Naval Postgraduate School.

This thesis developed a personal-computer-based model to utilize research results for the estimation of male high quality and high-tech qualified military available population. Research underlying the PC-based model estimated multinomial logistic regression equations using the National Longitudinal Survey of Youth Labor Force Behavior data over a set of explanatory variables for which data were available at the county level. Using the PC-based model, nationwide county-level measures of regional male recruit markets by size and mental quality for 1990 through 2010 were estimated. The PC-based model and the nationwide market estimates may be useful in recruiting management decisions such as resource allocating and recruiter goaling.

APPENDIX B

AFS-TO-JOB GROUP MAPPING

AFS-to-Job Group Mapping

Job Group		ASVAB Minimum Scores (As of Dec 93)
1. AIRCRAFT MECHANIC:		
M2	45234 - Tactical Aircraft Maintenance	M51
M3	45430 - Aerospace Propulsion Systems Maintenance	M44
M2	45431 - Aerospace Ground Equipment Maintenance	M51&E33
M2	45432 - Aircrew Egress System Maintenance	M57
M2	45433 - Aircraft Fuel Systems Maintenance	M51
M2	45434 - Aircraft Pneudraulic Systems Maintenance	M57
M2	45730 - Strategic Aircraft Maintenance	M51
M2	45731 - Helicopter Maintenance	M57
M2	45732 - Airlift Aircraft Maintenance	M51
M2	45830 - Aircraft Metals Technology	M51
G2	45831 - Nondestructive Inspection Specialist	G43
M2	45832 - Aircraft Structural Maintenance	M51
2. MISSILE MECHANIC:		
M2	41131 - Missile Maintenance	M51
M2	56632 - Liquid Fuels Systems Maintenance	M51
3. MUNITIONS MECHANIC:		
M1	46130 - Munitions Systems Maintenance	M61/E46
M1	46230 - Aircraft Armament Systems Maintenance	M61/E46
M1	46330 - Nuclear Weapons Specialist	M61
M1	46430 - Explosive Ordnance Disposal	M61&G60
4. VEHICLE OPERATOR/MECHANIC:		
M2	47230 - Special Purpose Vehicle and Equip Maint	M51
M3	47231 - Special Vehicle Maintenance	M44
M2	47232 - General Purpose Vehicle Maintenance	M51
M2	47233 - Vehicle Body Maintenance	M57
M3	55131 - Pavement and Construction Equip Operator	M44
M3	60330 - Vehicle Operator/Dispatcher	M44
M2	63130 - Fuels Specialist	M51&G39
5. FACILITY SUPPORT SPECIALIST:		
M2	36130 - Cable Systems Maintenance	M51
M2	36131 - Cable Splicing Installation and Maintenance	M51
M2	55230 - Structural Specialist	M51
M2	56631 - Utilities Systems Specialist	M51

	Job Group	ASVAB Minimum Scores (As of Dec 93)
G3	57130 - Fire Protection Specialist	G39

6. OPERATIONS CLERK:

A2	27131 - Air Field Management	A45
A2	27132 - Operations Resource Management	A45
A2	46530 - Munitions Operations	A45/G43
G2	55530 - Force Management Specialist	G43

7. LOGISTICS CLERK:

G2	55330 - Engineering Specialist	G48
G3	56630 - Pest Management Specialist	G39
A3	60230 - Passenger and Household Goods Specialist	A40
A3	60231 - Freight and Packaging Specialist	A40
A3	60535 - Air Transportation Specialist	A32&M51
A3	61231 - Subsistence Operations Specialist	A27
G3	62330 - Services Specialist	G30
A2	64530 - Inventory Management Specialist	A45/G43
G3	64531 - Material Storage and Distribution Specialist	G30
G2	91530 - Medical Materiel Specialist	G43

8. FINANCE CLERK:

G1	65130 - Contracting Specialist	G70
A1	67231 - Financial Management Specialists	A61
A1	67232 - Financial Services Specialist	A61

9. INFORMATION CLERK:

A3	70230 - Information Management Specialist	A32
A3	99604 - Postal Specialist	A32

10. PERSONNEL CLERK:

A2	73230 - Personnel Specialist	A45
A3	89230 - Chaplain Service Support Specialist	A40/G43
G3	75130 - Education Specialist	G42
G3	78130 - MWR and Services Specialist	G30

11. AIRCRAFT SYSTEMS OPERATOR:

G2	11230 - In-Flight Refueling Operator	G53
G2	11430 - Aircraft Loadmaster	G55
G2	11630 - Airborne Communications Systems Operator	G43

	Job Group	ASVAB Minimum Scores (As of Dec 93)
G2	11730 - Airborne Warning, Command, and Control Systems Operator	G53
G2	20930 - Defensive C^3 Countermeasures Specialist	G58

12. OPERATIONS SUPPORT SPECIALIST:

G3	12230 - Aircrew Life Support Specialist	G30
G2	25130 - Weather Specialist	G64&E50
G2	27230 - Air Traffic Control Operator	G53
G2	27430 - Command and Control Specialist	G48
G2	27630 - Aerospace Control and Warning System Specialist	G53
G2	39130 - Maintenance Data Systems Analysis Specialist	G53
G2	39230 - Maintenance Scheduling Specialist	G43
M3	45833 - Fabrication and Parachute Specialist	M44

13. COMBAT OPERATIONS SUPPORT SPECIALIST:

G2	11530 - Pararescue and Recovery Specialist	G43
G2	27530 - Tactical Air Command and Control Specialist	G48

14. INTELLIGENCE SPECIALIST:

G2	20130 - Intelligence Operations Specialist	G55
G1	20131 - Target Intelligence Specialist	G69
G2	20230 - Signal Intelligence Analysis Specialist	G58
G1	20530 - Electronic Intelligence Operations Specialist	G69
G2	20630 - Imagery Intelligence Specialist	G64

15. TRANSLATOR:

G1	208XX - Linguist	G69

16. IMAGE SPECIALIST:

G2	23131 - Visual Information Specialist	G43
G2	23132 - Still Photographic Specialist	G43
G2	23133 - Visual Information Production-Documentation Specialist	G58
G2	23330 - Imagery Production Specialist	G43
G3	70330 - Reprographics Specialist	G30

17. COMMUNICATION SYSTEM OPERATOR:

G2	20731 - Morse Systems Operator	G52
G2	20732 - Printer Systems Operator	G52
A2	49231 - Communications Systems Radio Specialist	A45

Job Group		ASVAB Minimum Scores (As of Dec 93)
18. COMPUTER SPECIALIST:		
G2	49131 - Communications-Computer Systems Operator	G43
G2	49132 - Communications-Computer Programming Specialist	G53
E2	49330 - Communications-Computer Systems Control Specialist	E67
G2	49630 - Communications-Computer Systems Plans and Programs Specialist	G58
G2	73130 - Personnel Systems Management Specialist	G43
19. SECURITY SPECIALIST:		
G2	75330 - Combat Arms Training and Maintenance Specialist	G43
G3	81130 - Security Specialist	G35
G3	81132 - Law Enforcement Specialist	G35
20. MEDICAL TECHNICIAN:		
G2	90130 - Aeromedical Specialist	G43
G2	90230 - Medical Service Specialist	G43
G2	90232 - Surgical Service Specialist	G43
G2	90330 - Radiologic Specialist	G43
G2	90430 - Cardiopulmonary Laboratory Specialist	G43
G2	90530 - Pharmacy Specialist	G43
G2	90630 - Health Services Management Support Specialist	G43
G2	90730 - Bioenvironmental Engineering Specialist	G48
G2	90830 - Public Health Specialist	G43
G2	91130 - Aerospace Physiology Specialist	G43
G2	91235 - Optometry Specialist	G43
G2	91330 - Physical Therapy Specialist	G43
G2	91430 - Mental Health Service Specialist	G43
G2	92430 - Medical Laboratory Specialist	G58
G2	92431 - Histopathology Specialist	G43
G2	92630 - Diet Therapy Specialist	G43
G2	98130 - Dental Assistant Specialist	G43
G2	98230 - Dental Laboratory Specialist	G64
21. MUSICIAN:		
G3	87XXX - Band	G30/A27
22. MEDIA SPECIALIST:		
G1	79130 - Public Affairs Specialist	G69
G1	79131 - Radio and Television Broadcasting	G69

Job Group		ASVAB Minimum Scores (As of Dec 93)
23. AIRCRAFT ELECTRONICS TECHNICIAN:		
E2	11830 - Airborne Computer Systems Specialist	E67
E2	11831 - Airborne C^3 Equipment Specialist	E67
E2	11832 - Airborne Radar Systems Specialist	E67
E2	30830 - Instrumentation and Telemetry System Specialist	E67
E2	45231 - F-15 Avionics Systems Specialist	E67
E2	45232 - F-16 Avionics Systems Specialist	E67
E2	45233 - F/FB-111 Avionics Systems Specialist	E67
E2	45531 - Avionics, Guidance, and Control Systems Specialist	E67
E2	45532 - Communications and Navigation Systems Specialist	E67
E2	45533 - Weapon Control System Specialist	E67
E2	45534 - Airborne Warning and Control Radar Specialist	E67
E2	45536 - Airborne Command Post Communication Equipment Specialist	E67
E2	45630 - B-52 G/H Bomb-Nav System Specialist	E67
E2	45631 - Electronic Warfare Systems Specialist	E67
E2	45733 - B-1B/B-2 Avionics Systems Specialist	E67
24. ELECTRONIC AIRCRAFT SUPPORT EQUIPMENT TECHNICIAN:		
E2	30331 - Air Traffic Control Radar Specialist	E67
E2	30432 - Meteorology and Navigation Systems Specialist	E67
E2	30930 - Space Systems Equipment Maintenance Specialist	E67
E2	45134 - F-15 Avionics Test Station Specialist	E67
E2	45135 - F-16/A-10 Avionics Test Station Specialist	E67
E2	45136 - F/FB-111 Avionics Test Station Specialist	E67
E2	45137 - B-1B Avionics Test Station Specialist	E67
E2	45331 - Aircraft Guidance and Control Specialist	E67
25. MISSILE ELECTRONIC TECHNICIAN:		
E2	41130 - Missile Systems Maintenance Specialist	E67
E2	41132 - Missile Facilities Specialist	E67
E2	46630 - Air Launched Missile Systems Specialist	E67
26. GENERAL ELECTRONIC EQUIPMENT TECHNICIAN:		
E2	30430 - Wideband Communications Equipment Specialist	E67
E2	30434 - Ground Radio Communications Specialist	E67
E2	30435 - Television Systems Specialist	E67
E2	30436 - Satellite Communications Systems Equipment Specialist	E67
E2	30534 - Electronic Computer and Switching Systems Specialist	E67
E2	30636 - Secure Communications Systems Maintenance Specialist	E67
E2	32430 - Precision Measuring Equipment Laboratory Specialist	E67
E2	91830 - Biomedical Equipment Specialist	E67

	Job Group	ASVAB Minimum Scores (As of Dec 93)
	27. ELECTRICAL SYSTEMS TECHNICIAN:	
E3	54232 - Electrical Power Production Specialist	E43&M57
E3	54530 - HVAC and Refrigeration Specialist	E33/M51
E3	45235 - Tactical Elect and Environ Systems Maintenance	E45&M45
E3	45435 - Strategic Aircraft Elect and Environ Systems Maint	E45&M45
E3	45436 - Aircraft Elect and Environ Systems Maint	E45&M45
E3	27730 - Space Systems Operations Specialist	E58
E3	36231 - Telephone Switching Specialist	E46
E3	36234 - Telephone and Data Circuitry Equipment Specialist	E46
E3	40430 - Visual Information Equipment Maintenance Specialist	E39
E3	54230 - Electrical Systems Specialist	E33
	28. PRECISION ELECTRONIC EQUIPMENT TECHNICIAN:	
E1	45530 - Photo and Sensor Maintenance Specialist	E72
E1	30332 - Aircraft Control and Warning Radar Specialist	E77
E1	30333 - Automatic Tracking Radar specialist	E72
E1	99104 - Systems Repair Technician	E81&M89
E1	99105 - Scientific Measurement Technician	E81&M89
E1	99106 - Applied Sciences Technician	E81&M89

APPENDIX C

OCCUPATIONAL INTEREST SURVEY

OCCUPATIONAL INTEREST SURVEY

INSTRUCTIONS

PLEASE DO NOT MARK ON THESE INSTRUCTIONS OR ON THE ATTACHED PAGES – MARK ONLY ON THE SCANNABLE ANSWER SHEET PROVIDED

The purpose of this survey is to measure your level of interest in different groups of Air Force jobs. The survey is for research purposes only. The data will not be used to classify you into a specialty or assign you to a job. The results of the survey will be used to study and review Air Force recruiting policies and procedures.

The survey consists of 28 job groups that cover the full range of Air Force enlisted specialties. For each group you are to mark your level of interest in doing the kind of work described by using the following 10-point scale:

Not Interested				Neutral					Interested
A	B	C	D	E	F	G	H	I	J

Before starting the survey, please read the Privacy Act statement on the next page. Then write your Social Security Account Number (SSAN) on the scannable answer sheet provided. After writing your SSAN, fill in the correct bubble below each number. Your SSAN is needed so we can match your job interest data with other information in your personnel records. Again, this data will be used only for statistical analysis purposes. It will not become part of your permanent personnel record.

The survey is simple and should only take you a few minutes to finish. The job groups on the next 5 pages are numbered 1 through 28. Read each job group description and find the matching number on the scannable answer sheet. Indicate your interest in the job group by marking the bubble that matches your interest level using the scale printed at the top of each page. Please be sure to mark an interest level for all 28 job groups. In making your choices, consider only your interest in each of the job groups. **Do not consider your ability to qualify for the job or your currently assigned specialty.**

Please mark the bubbles carefully; make the marks dark and keep them inside the bubbles. Thoroughly erase any errors or stray marks.

PRIVACY ACT STATEMENT

In accordance with AFR 12-35, paragraph 10, the following information is provided as required by the Privacy Act of 1974.

AUTHORITY: AFR 169-3, Using Human Subjects in Research, Development, Test, and Evaluation; 10 U.S.C. 8012, Secretary of the Air Force, Power and Duties, Delegation by Executive Order 9397, 22 November 1943. USAF Survey Control Number (SCN)) 93-101A applies.

PURPOSE: To collect occupational interest information from Air Force enlisted personnel.

ROUTINE USE: To support Air Force research to improve the recruiting, selection, and classification process. The information is for research purposes only and will not become part of any participant's permanent personnel record, nor will it affect any participant's opportunity for promotion, assignment, or retention.

PARTICIPATION: Your participation is this project and furnishing of your Social Security Account Number (SSAN) is voluntary. However, your cooperation in this effort is vitally important in helping the Air Force better understand the occupational interests of the enlisted force. Your SSAN is essential for matching information in Air Force personnel files and conducting meaningful analyses. Failure to provide it could render the questionnaire information unusable.

Not Interested				Neutral					Interested
A	B	C	D	E	F	G	H	I	J

1. AIRCRAFT MECHANIC: Inspect, remove, replace, and repair mechanical pieces on aircraft and aircraft-related parts. The work is mechanical and airmen use hand tools, power tools, solvents, lubricants, and other chemicals. The work is done on the flight line or in a hangar and in remote sites. It is done under all weather conditions. Shift-work and temporary trips may be required. Some job titles are: Tactical Aircraft Mechanic, Jet Engine Mechanic, Aerospace Ground Equipment Mechanic, and Aircrew Egress Systems Mechanic.

2. MISSILE MECHANIC: Inspect, remove, replace, and repair mechanical pieces on missiles and missile-related parts. The work is mechanical and requires the use of hand tools, power tools, solvents, lubricants, and other chemicals. The work is performed in or around strategic missile silos and in remote sites. It is done under all weather conditions. Shift-work and temporary trips may be required. Some job titles are: Missile Mechanic and Liquid Fuels Systems Mechanic.

3. MUNITIONS MECHANIC: Inspect, remove, replace, and repair mechanical parts on weapons and munitions (bombs (conventional and nuclear), rockets, explosives, ammunition, etc.). The work is mechanical and requires the use of hand tools, power tools, solvents, lubricants, and other chemicals. The work is performed on or around the flight line, or in a hangar or munitions storage facility. Also, it is done in remote locations under all weather conditions. Shift-work and temporary trips may be required. The handling and disposal of dangerous materials may be required. Some job titles are: Munitions Systems Mechanic, Nuclear Weapons Mechanic, and Explosive Ordnance Disposal Specialist.

4. VEHICLE OPERATOR/MECHANIC: Use, inspect, and repair vehicles such as trucks, tractors, jeeps, automobiles, etc. The work is mechanical and is performed on a base (some of which are in remote locations). Unusual situations may arise such as trips to remote sites. Driving and the use of automotive repair tools and parts may be required. Some job titles are: Special Vehicle Mechanic, Vehicle Body Mechanic, Vehicle Operator/Dispatcher, and Pavement and Construction Equipment Operator.

5. FACILITY SUPPORT SPECIALIST: Construct, maintain, and repair buildings, grounds, runways, and other structures. The work is mechanical and is often performed outside. It may include heavy lifting and physical activity. The use of both hand and power tools may be required. Some job titles are: Cable Systems Specialist, Structural Specialist, and Utilities Systems Specialist.

6. OPERATIONS CLERK: Schedule, track, and aid with the management of Air Force operations. The work is administrative and is performed in an office environment. It may involve working on complex, large-scale processes and issues. Working under pressure and meeting conflicting schedule demands may be required. Using computers to fill-out and process forms is required. Some job titles are: Air Field Management Clerk, Operations Resource Management Clerk, and Force Management Clerk.

Not Interested				Neutral					Interested
A	B	C	D	E	F	G	H	I	J

7. LOGISTICS CLERK: Plan and manage the movement, storage, and distribution of people, supplies, and gear. The work is mainly administrative although some lifting and other physical activity is required. The work is performed in almost any environment in both large and small sites. Using computers to fill-out and process forms is required. Some job titles are: Air Transportation Clerk, Inventory Management Clerk, and Freight and Packaging Clerk.

8. FINANCE CLERK: Plan, track, and manage financial procedures. The duties are administrative and include budget preparation, funds accounting, and financial reporting. The work involves paperwork and some computer use. It is conducted in an office environment. Some job titles include: Financial Management Clerk and Contracting Clerk.

9. INFORMATION CLERK: Manage the flow of information, mainly paper, in and between organizations. The work is administrative and is done in an office environment using computers. Some job titles are: Information Management Clerk and Postal Clerk.

10. PERSONNEL CLERK: Plan, manage, and conduct personnel-related activities. The work is administrative and involves a lot of interaction with people. Processing new airmen and base transfers may be required. The work is performed in an office environment using computers and filling-out paperwork. Some job titles are: Personnel Clerk, Education Clerk, and Chaplain Service Support Clerk.

11. AIRCRAFT SYSTEMS OPERATOR: Serve as an aircrew member and use on-board aircraft systems. The work is done in-flight. It requires travel and duty away from home. Some job titles are: In-Flight Refueling Operator, Aircraft Loadmaster, and Airborne Warning, Command, and Control Systems Operator.

12. OPERATIONS SUPPORT SPECIALIST: Provide information, material, and services for the support of flying operations using computers, instruments, and machines. The work is done in many areas including the flightline, control tower, and remote sites. Shift work and extended trips may be required. Some job titles are: Aircrew Life Support Specialist, Weather Specialist, and Air Traffic Control Specialist.

13. COMBAT OPERATIONS SUPPORT SPECIALIST: Support combat operations by setting up and using forward placed tactical command and control posts. Also, rescue downed aircrew members. The work is done in hostile combat areas, and involves jumping out of aircraft and other life-threatening activities. The physical demands are extreme. Some of the job title are Pararescue and Recovery Specialist and Tactical Air Command and Control Specialist.

Not Interested				Neutral					Interested
A	B	C	D	E	F	G	H	I	J

14. INTELLIGENCE SPECIALIST: Gather, process, study and report intelligence data on foreign government actions. The work is done almost anywhere. It requires extended periods of remote duty and a high-level security clearance. The knowledge of foreign languages, different cultures, and the use of computers is required. Some job titles are: Intelligence Operations Specialist, Signal Intelligence Analysis Specialist, and Imagery Intelligence Specialist.

15. TRANSLATOR: Translate written and verbal information from one language to another. The work may be done in an office environment and with computers. It may also require flying and/or extended time at remote locations. The work may require a high-level security clearance. One of the job titles is Linguist (various languages).

16. IMAGE SPECIALIST: Create, process, store, and distribute visual information, including photography, graphics, xerography, infrared, and other sources. The work is generally done in an office environment. Some job titles are: Visual Information Specialist, Still Photographic Specialist, and Imagery Production Specialist.

17. COMMUNICATION SYSTEM OPERATOR: Use equipment for the remote broadcast of information. The work is usually done in an office environment, but may involve duty at remote sites. Some job titles are: Morse Systems Operator, Printer Systems Operator, and Communication Systems Radio Operator.

18. COMPUTER SPECIALIST: Plan, program, and use computer systems. The work is usually done in an office environment. It involves the use of computer logic and large, complex data bases. Some job titles are: Computer Operations Specialist, Computer Programming Specialist, and Computer Systems Control Specialist.

19. SECURITY SPECIALIST: Help maintain the security of Air Force installations through the careful use of force. The work is done both outside and inside. It may require extended periods in remote locations under all weather conditions. Weapons and the lethal use of force may be part of the job. Dogs may be used for drug and weapon searches. Some job titles are: Combat Arms Training and Maintenance Specialist, Security Specialist, and Law Enforcement Specialist.

20. MEDICAL TECHNICIAN: Aid doctors and nurses in the planning, management, and delivery of medical care. The work is done in a hospital or clinic, but may involve deployment to remote locations. The work involves dealing with illness, injury, and possibly dangerous drugs and equipment. Some job titles are: Aeromedical Technician, Medical Service Technician, Surgical Service Technician, and Dental Technician.

Not Interested				Neutral					Interested
A	B	C	D	E	F	G	H	I	J

21. MUSICIAN: Play a musical instrument in a marching band, orchestra, or other musical ensemble. The work is performed at many locations on and off military bases. It is done in front of crowds during ceremonies. One of the job titles is Musician (various instruments).

22. MEDIA SPECIALIST: Prepare and send out information on the Air Force to many internal and external groups. It is done with all types of media. The work is usually done in an office environment. Some job titles are: Public Affairs Specialist and Radio and Television Broadcast Specialist.

23. AIRCRAFT ELECTRONICS TECHNICIAN: Inspect, test, remove, replace, and repair electronic pieces on aircraft parts. The work is electronic and requires the use of precision instruments and tools. It often involves finding problems in complex electronic circuits. The work is done on the flight line or in a hangar. It may also be done in remote areas under all weather conditions. Shift-work and temporary trips are required. Some job titles are: F-15 Avionics Systems Technician, Electronic Warfare Systems Technician, and Communication and Navigation Systems Technician.

24. ELECTRONIC AIRCRAFT SUPPORT EQUIPMENT TECHNICIAN: Inspect, test, remove, replace, and repair electronic parts on ground-based aircraft support equipment. The work is electronic and requires the use of precision instruments and tools. It often involves finding problems in complex electronic circuits. The work is done on the flight line or in a hangar. It is done in remote locations under all weather conditions. Shift-work and temporary trips are required. Some job titles are: Space Systems Equipment Maintenance Technician, Air Traffic Control Radar Technician, and F-15 Avionics Test Station Technician.

25. MISSILE ELECTRONIC TECHNICIAN: Inspect, test, remove, replace, and repair electronic parts on missiles and related gear. The work is electronic and requires the use of precision instruments and tools. It often involves finding problems in complex electronic circuits. The work is done on the flight line, in a hangar, or in or near missile silos. It may be done in remote locations under all weather conditions. Shift-work and temporary trips are required. Some job titles are: Missile Systems Maintenance Technician, Missile Facilities Technician, and Air Launched Missile Systems Technician.

26. GENERAL ELECTRONIC EQUIPMENT TECHNICIAN: Inspect, test, remove, replace, and repair electronic parts on ground-based electronic and communications equipment. The work is electronic and requires the use of precision instruments and tools. It often involves finding problems in complex electronic circuits. The work is done in many locations ranging from climate-controlled laboratories to remote radar sites. Shift-work and temporary trips may be required. Some job titles are: Wideband Communications Equipment Technician, Satellite Communications Systems Equipment Technician, and Biomedical Equipment Technician.

Not Interested					Neutral				Interested
A	B	C	D	E	F	G	H	I	J

27. ELECTRICAL SYSTEMS TECHNICIAN: Install, inspect, test, remove, replace, and repair electrical wiring and components in buildings, hangars, powerplants, and aircraft. The work is primarily electrical with some mechanical tasks and requires the use of instruments and tools. It often involves finding problems in large electrical circuits. The work is done in many locations ranging from offices to remote field sites. Shift-work and temporary trips may be required. Some job titles are: Electrical Power Production Technician; Heating, Ventilation, Air Conditioning and Refrigeration Technician; Telephone Switching Technician; and Electrical Systems Technician.

28. PRECISION ELECTRONIC EQUIPMENT TECHNICIAN: Install, inspect, test, remove, replace, and repair extremely precise and complex electronic equipment. The work requires the use of sensitive electronic instruments and very detailed instructions and procedures. The work is usually done in a laboratory or office, but may require some travel to remote locations. Some job titles are: Photo and Sensor Maintenance Technician; Automatic Tracking Radar Technician; and Scientific Measurement Technician.

When you are finished, please return this survey and your completed answer sheet to the test administrators.

APPENDIX D

RECRUITING DIFFICULTY SURVEY

RECRUITING DIFFICULTY SURVEY

INSTRUCTIONS

The attached Air Force-approved survey is being sent to all USAF recruiting flight supervisors and MEPS Liaison NCOs across the country. If you do not fit into one of these two categories, please return the survey to your squadron superintendent now. The survey is anonymous, so you need not provide your name or social security number. We do ask that you identify your squadron, rank, type of duty (flight supervisor or LNCO), and amount of recruiting experience so we can better analyze the results. When you have completed the survey, place it in the envelope provided, add a stamp, and drop it in the mail.

The survey is designed to record your best judgment of the difficulty in filling various categories of Air Force enlisted jobs. For the purpose of this study, recruiting difficulty is defined as follows:

RECRUITING DIFFICULTY: The overall recruiting effort required to fill jobs in a particular category, considering **both** the number of people qualified and interested in the category **and** the number of jobs to be filled in the category. In other words, a category can be hard to recruit for if very few people are qualified and interested in the category or if there are many jobs in that category to be filled.

This information will be used in a research project to determine the cost of recruiting individuals with the interests and aptitudes the Air Force needs. As you know, the Air Force divides enlisted jobs into four basic categories (Mechanical, Administrative, General, and Electronic). For the purpose of this study, we further divide jobs into three aptitude levels within each category (high, medium, and low). This produces the following 12 categories:

APTITUDE	**Mechanical**	**Administrative**	**General**	**Electronic**
High	M1	A1	G1	E1
Medium	M2	A2	G2	E2
Low	M3	A3	G3	E3

Please read the Privacy Act statement on the next page and the remainder of the instructions before beginning the survey.

PRIVACY ACT STATEMENT

In accordance with AFR 12-35, paragraph 10, the following information is provided as required by the Privacy Act of 1974.

AUTHORITY: AFR 169-3, Using Human Subjects in Research, Development, Test, and Evaluation; 10 U.S.C. 8012, Secretary of the Air Force, Power and Duties, Delegation by Executive Order 9397, 22 November 1943. USAF Survey Control Number (SCN) 93-101B applies.

PURPOSE: To collect recruiting difficulty information from Air Force recruiting personnel.

ROUTINE USE: To support Air Force research to improve the recruiting, selection, and classification process. The information is for research purposes only and will not become part of any participant's permanent personnel record, nor will it affect any participant's opportunity for promotion, assignment, or retention.

PARTICIPATION: Your participation in this project and furnishing of demographic information is voluntary. However, your cooperation in this effort is vitally important in helping the Air Force better understand the difficulty of recruiting the enlisted force.

Completing the survey is quite simple and should only take you a few minutes. On the next two pages we have listed all 12 categories, including a typical Air Force Specialty for each. All you have to do is, for each category, circle the number on the recruiting difficulty scale (1 to 7) that, in your experience, indicates the level of difficulty in filling jobs in that category.

BEFORE YOU BEGIN, PLEASE FILL IN THE BACKGROUND INFORMATION ON THE TOP OF THE NEXT PAGE

USAF SCN 93-101B

RECRUITING DIFFICULTY SURVEY

Squadron: _______ Flight Supervisor or LNCO: _______________

Rank: _______ Total Months of Recruiting Experience: _____

PLEASE CIRCLE THE RECRUITING DIFFICULTY RATING ON THE SCALE AFTER EACH JOB CATEGORY

M1. High Aptitude Mechanical Jobs (Example: 46330, Nuclear Weapons Specialist (M61))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

M2. Medium Aptitude Mechanical Jobs (Example: 45730, Strategic Aircraft Maint (M51))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

M3. Low Aptitude Mechanical Jobs (Example: 60330, Vehicle Operator/Dispatcher (M44))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

A1. High Aptitude Admin Jobs (Example: 67231, Financial Management Specialist (A61))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

A2. Medium Aptitude Admin Jobs (Example: 73230, Personnel Specialist (A45))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

A3. Low Aptitude Admin Jobs (Example: 70230, Information Management Specialist (A32))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

G1. High Aptitude General Jobs (Example: 208XX, Linguist (G69))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

G2. Medium Aptitude General Jobs (Example: 49131, Comm-Computer Sys Operator (G43))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

G3. Low Aptitude General Jobs (Example: 12230, Aircrew Life Support Specialist (G30))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

E1. High Aptitude Elect Jobs (Example: 30333, Automatic Tracking Radar Specialist (E72))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

E2. Medium Aptitude Elect Jobs (Example: 45231, F-15 Avionics Systems Specialist (E67))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

E3. Low Aptitude Elect Jobs (Example: 54230, Electrical Systems Specialist (E33))

1 2 3 4 5 6 7
Easier to Fill <---------- | ----------> Harder to Fill

When you are finished please place the completed survey in the envelope provided, add a stamp, and drop it in the mail. Thank you for your time and expertise in helping us answer some important questions about Air Force recruiting.

APPENDIX E

JOB GROUP-TO-APTITUDE/INTEREST CATEGORY MAPPING

(Weights are the proportion of the aptitude/interest category's AFSs that are in the Job Group)

Job Gp	M1	M2	M3	A1	A2	A3	G1	G2	G3	E1	E2	E3
1		.50	.20					.02				
2		.10										
3	1.00											
4		.20	.60									
5		.20							.09			
6					.50			.02				
7					.17	.57		.04	.28			
8				1.00			.17					
9						.29						
10					.17	.14			.18			
11								.10				
12			.20					.12	.09			
13								.04				
14							.33	.06				
15							.17					
16								.08	.09			
17					.16			.04				
18								.08			.03	
19								.02	.18			
20								.38				
21									.09			
22							.33					
23											.42	
24											.23	
25											.09	
26											.23	
27												1.00
28										1.00		

APPENDIX F

SPREADSHEET

USAF NPS ENLISTED RECRUITING COST MODEL

SCENARIO SET-UP

Run Name =	FY 93 Baseline			
Total Enlistments Required =	31500			
Number of Prod Recruiters =	991			
DEP Attrition Rate =	0.12			
% of Applicants Processed =	0.33			

Applicant Joint Apt/Int Distribution	Mech	Admin	Gen	Elect
1-High	0.05	0.06	0.05	0.04
2-Medium	0.08	0.09	0.14	0.06
3-Low	0.1	0.1	0.13	0.1
Sum =	1	[must be 1]		

Job Distribution	Mech	Admin	Gen	Elect
1-High	0.06	0.01	0.02	0.01
2-Medium	0.21	0.05	0.2	0.12
3-Low	0.07	0.05	0.18	0.02
Sum =	1	[must be 1]		

Desired Over-Qual Rates	Mech	Admin	Gen	Elect
2 jobs filled by 1s	0.79	0.79	0.55	0.82
3 jobs filled by 1s	0.67	0.76	0.32	0.68
3 jobs filled by 2s	0.19	0.18	0.62	0.2

	Enlistments Required	Contracts Required	Applicants Required (RecDiff)	Applicants Processed	Total Recruiting Cost ($M) **	Marginal Cost per Enlistment ($)
M1	8593	9765	195300	64449	101.9	3675
M2	1808	2055	25683	8475	74.47	2297
M3	309	351	3508	1158	70.89	1838
A1	2756	3132	52202	17227	78.76	3063
A2	614	698	7756	2559	71.58	2042
A3	95	107	1074	354	70.5	1838
G1	5909	6715	134305	44321	92.04	3675
G2	6350	7216	51545	17010	78.66	1313
G3	340	387	2974	981	70.8	1413
E1	3843	4367	109176	36028	87.98	4594
E2	806	916	15273	5040	72.79	3063
E3	76	86	859	284	70.46	1838
	=====	====	=====	=====	=====	
Total	31500	35795	195300 *	64449 *	101.9 *	

Ratio of Highest to Lowest Marginal Cost = 3.5

* The total applicants required, applicants processed, and total recruiting cost are for the most difficult category to fill, not the sum across all categories. By filling the most difficult category, all other categories are filled as well.

** Includes advertising, mil/civ pay, facilities, travel, per diem, and all other cost associated with NPS recruiting = $70,960 per recruiter (fixed cost) + $490 per applicant (variable cost)